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Polar Bears: Today's Canaries in the Coal Mine?

Countless politicians proclaim that global warming has emerged as the preeminent issue of our era. The European Union calls it "one of the most threatening issues that we are facing today." Former prime minister Tony Blair of the United Kingdom sees it as "the single most important issue." German chancellor Angela Merkel has vowed to make climate change the top priority within both the G8 and the European Union in 2007, and Italy's Romano Prodi sees climate change as the real threat to global peace. Presidential contenders from John McCain to Hillary Clinton express real concern over the issue. Several coalitions of states have set up regional climate-change initiatives, and in California Republican governor Arnold Schwarzenegger has helped push through legislation saying that global warming should be a top priority for the state. And of course, Al Gore has presented this message urgently in his lectures as well as in the book and Oscar-winning movie *An Inconvenient Truth*.

In March 2007, while I waited to give evidence to a con-

gressional hearing on climate change, I watched Gore put his case to the politicians. It was obvious to me that Gore is sincerely worried about the world's future. And he's not alone in worrying. A raft of book titles warn that we've reached a *Boiling Point* and will experience a *Climate Crash*. One is even telling us we will be the *Last Generation* because "nature will take her revenge for climate change." Pundits aiming to surpass one another even suggest that we face medieval-style impoverishment and societal collapse in just forty years if we don't make massive and draconian changes to the way we live.

Likewise, the media pound us with increasingly dramatic stories of our ever worsening climate. In 2006, *Time* did a special report on global warming, with the cover spelling out the scare story with repetitive austerity: "Be worried. Be *very* worried." The magazine told us that the climate is crashing, affecting us both globally by playing havoc with the biosphere and individually through such health effects as heatstrokes, asthma, and infectious diseases. The heart-breaking image on the cover was of a lone polar bear on a melting ice floe, searching in vain for the next piece of ice to jump to. *Time* told us that due to global warming bears "are starting to turn up drowned" and that at some point they will become extinct.

Padding across the ice, polar bears are beautiful animals. To Greenland—part of my own nation, Denmark—they are a symbol of pride. The loss of this animal would be a tragedy. But the real story of the polar bear is instructive. In many ways, this tale encapsulates the broader problem with the climate-change concern: once you look closely at the supporting data, the narrative falls apart.

Al Gore shows a picture similar to *Time*'s and tells us "a new scientific study shows that, for the first time, polar bears have been drowning in significant numbers." The World Wildlife Fund actually warns that polar bears might stop reproducing by 2012 and thus become functionally extinct in less than a decade. In their pithy statement, "polar bears will be consigned to history, something that our grandchildren can only read about in books." *The Independent* tells us that temperature increases "mean polar bears are wiped out in their Arctic homeland. The only place they can be seen is in a zoo."

Over the past few years, this story has cropped up many times, based first on a World Wildlife Fund report in 2002 and later on the Arctic Climate Impact Assessment from 2004. Both relied extensively on research published in 2001 by the Polar Bear Specialist Group of the World Conservation Union.

But what this group really told us was that of the twenty distinct subpopulations of polar bears, one or possibly two were declining in Baffin Bay; more than half were known to be stable; and two subpopulations were actually *increasing* around the Beaufort Sea. Moreover, it is reported that the global polar-bear population has *increased* dramatically over the past decades, from about five thousand members in the 1960s to twenty-five thousand today, through stricter hunting regulation. Contrary to what you might expect—and what was not pointed out in any of the recent stories—the two populations in decline come from areas where it has actually been getting colder over the past fifty years, whereas the two increasing populations reside in areas where it is getting warmer. Likewise, Al Gore's comment on

drowning bears suggests an ongoing process getting ever worse. Actually, there was a single sighting of four dead bears the day after "an abrupt windstorm" in an area housing one of the increasing bear populations.

The best-studied polar-bear population lives on the western coast of Hudson Bay. That its population has declined 17 percent, from 1,200 in 1987 to under 950 in 2004, has gotten much press. Not mentioned, though, is that since 1981 the population had soared from just 500, thus eradicating any claim of a decline. Moreover, nowhere in the news coverage is it mentioned that 300 to 500 bears are shot each year, with 49 shot on average on the west coast of Hudson Bay. Even if we take the story of decline at face value, it means we have lost about 15 bears to global warming each year, whereas we have lost 49 each year to hunting.

In 2006, a polar-bear biologist from the Canadian government summed up the discrepancy between the data and the PR: "It is just silly to predict the demise of polar bears in 25 years based on media-assisted hysteria." With Canada home to two-thirds of the world's polar bears, global warming will affect them, but "really, there is no need to panic. Of the 13 populations of polar bears in Canada, 11 are stable or increasing in number. They are not going extinct, or even appear to be affected at present."

The polar-bear story teaches us three things. First, we hear **vastly exaggerated and emotional claims** that are simply not supported by data. Yes, it is likely that disappearing ice will make it harder for polar bears to continue their traditional foraging patterns and that they will increasingly take up a lifestyle similar to that of brown bears, from which

they evolved. They may eventually decline, though dramatic declines seem unlikely. But over the past forty years, the population has increased dramatically and the populations are now stable. The ones going down are in areas that are getting *colder.* Yet we are told that global warming will make polar bears extinct, possibly within ten years, and that future kids will have to read about them in storybooks.

Second, polar bears are **not the only story.** While we hear only about the troubled species, it is also a fact that many species will do *better* with climate change. In general, the Arctic Climate Impact Assessment projects that the Arctic will experience *increasing* species richness and higher ecosystem productivity. It will have less polar desert and more forest. The assessment actually finds that higher temperatures mean more nesting birds and more butterflies. This doesn't make up for the polar bears, but we need to hear both parts of the story.

The third point is that **our worry makes us focus on the wrong solutions.** We are being told that the plight of the polar bear shows "the need for stricter curbs on greenhouse-gas emissions linked to global warming." Even if we accept the flawed idea of using the 1987 population of polar bears around Hudson Bay as a baseline, so that we lose 15 bears each year, what can we do? If we try helping them by cutting greenhouse gases, we can at the very best avoid 15 bears dying. We will later see that realistically we can do not even close to that much good—probably we can save about 0.06 bears per year. But 49 bears from the same population are getting shot each year, and this we can easily do something about. Thus, if we really want a stable population of polar bears, dealing first with the 49 shot ones might be both a

smarter and a more viable strategy. Yet it is not the one we end up hearing about. In the debate over the climate, we often don't hear the proposals that will do the most good but only the ones that involve cutting greenhouse-gas emissions. This is fine if our goal is just to cut those gases, but presumably we want to improve human conditions and environmental quality. Sometimes greenhouse-gas cuts might be the best way to get this, but often they won't be. We must ask ourselves if it makes more sense to help 49 bears swiftly and easily or 0.06 bears slowly and expensively.

The argument in this book is simple.

1. **Global warming is real and man-made.** It will have a serious impact on humans and the environment toward the end of this century.
2. Statements about the **strong, ominous, and immediate consequences of global warming are often wildly exaggerated,** and this is unlikely to result in good policy.
3. **We need simpler, smarter, and more efficient solutions for global warming** rather than excessive if well-intentioned efforts. Large and very expensive CO_2 cuts made now will have only a rather small and insignificant impact far into the future.
4. **Many other issues are much more important than global warming.** We need to get our perspective back. There are many more pressing problems in the world, such as hunger, poverty, and disease. By addressing them, we can help more people, at lower cost, with a much higher chance of success than by pursuing drastic climate policies at a cost of trillions of dollars.

These four points will rile a lot of people. We have become so accustomed to the standard story: climate change is not only real but will lead to unimaginable catastrophes, while doing something about it is not only cheap but morally right. We perhaps understandably expect that anyone questioning this line of reasoning must have evil intentions. Yet I think—with the best of intentions—it is necessary that we at least allow ourselves to examine our logic before we embark on the biggest public investment in history.

We need to remind ourselves that our ultimate goal is not to reduce greenhouse gases or global warming per se but to improve the quality of life and the environment. We all want to leave the planet in decent shape for our kids. Radically reducing greenhouse-gas emissions is not necessarily the best way to achieve that. As we go through the data, we will see that it actually is one of the least helpful ways of serving humanity or the environment.

I hope that this book can help us to better understand global warming, be smarter about solutions to it, and also regain our perspective on the most effective ways to make the world a better place, a desire we all share.

2

It's Getting Hotter: The Short Story

While global warming has many effects, like rising sea levels, melting glaciers, and maybe more ferocious hurricanes, **let us start by looking at just one factor: temperature.**

As we call it global warming, temperature is perhaps the obvious place to begin. So let's start by asking the crucial questions: What happens when temperatures increase? What can we do about this? What does it cost?

The reason we are concerned about global warming is due to the so-called greenhouse effect, the fundamental principle of which is quite simple and entirely uncontroversial. Several types of gases can reflect or trap heat, most importantly water vapor and carbon dioxide (CO_2). These greenhouse gases trap some of the heat emitted by the earth, rather like a blanket wrapped around the globe. The basic greenhouse effect is good: if the atmosphere did not contain greenhouse gases, the average temperature on the earth would be approximately 59°F colder, and it is unlikely that life as we know it would be able to exist.

The problem is that people have substantially increased

the quantity of CO_2 in the atmosphere, mainly from burning fossil fuels, such as coal, oil, and gas. As natural processes only slowly remove CO_2 from the atmosphere, our annual emissions have increased the total atmospheric CO_2 content—the CO_2 concentration—such that today it is 36 percent higher than in preindustrial times.

Absent a major policy change, we will continue to burn more fossil fuels over the coming century. This is especially true for the rapidly industrializing developing world, such as China and India. Whereas the developing world now is responsible for about 40 percent of the annual global carbon emissions, by the end of the century that figure will more likely be 75 percent. More CO_2 will hold on to more heat and raise temperatures. This is the man-made greenhouse effect.

Let's look at what will happen when we turn up the heat.

When talking about future climate, we obviously cannot observe it directly. Instead, researchers must make predictions about crucial factors, such as how much oil and coal each nation will use over the coming century, then put the resultant CO_2 emissions into hugely complex models that tell us how these new levels of greenhouse gases will affect the temperature, sea levels, and so forth.

Our best information comes from the United Nations' Intergovernmental Panel on Climate Change, or IPCC. Every six years or so, it gathers the best information we have on climate models and climate effects. In its "standard" future scenario, the IPCC predicts that the global temperature in 2100 will have risen on average 4.7°F from the current range. But nobody actually lives at the global average. To begin with, global warming will make land warm up

faster than it will water. (It's much easier to warm up a couple of yards of earth than to warm up two deep miles of ocean.) Moreover, global warming increases *cold* temperatures much more than warm temperatures, thus it increases night and winter temperatures much more than day and summer temperatures. The reality of climate change isn't necessarily an unusually fierce summer heat wave. More likely, we may just notice people wearing fewer layers of clothes on a winter's evening. Likewise, global warming increases temperatures in temperate and Arctic regions much more than in tropical areas.

We have already experienced this warming pattern in the twentieth century. Globally, winter temperatures have increased much more than summer temperatures, and night temperatures have increased much more than day temperatures. Moreover, winter temperatures have been increasing the most in colder locations—more than three-quarters of the winter warming in the Northern Hemisphere has been confined to the very cold high-pressure systems of Siberia and northwestern North America.

Not surprisingly, this has meant that the United States, northern and central Europe, China, Australia, and New Zealand have experienced fewer frost days. However, with most warming heating up nights and winters, only Australia and New Zealand have had their maximum temperatures go up. For the United States, the maximum temperatures show no trend, and for China the maximum has even declined. In the Central England Temperature series, which is the longest record of temperatures in the world, going back to 1659, there has been a clear reduction in the number of cold days but no increase in the number of hot days.

But what will happen over the coming century, with temperatures rising 4.7°F? The standard story is that our world will become a very unpleasant one. Whenever there is a heat wave, journalists write that it might be a glimpse of much worse things to come. As one environmentalist has said, "If you don't like the current heat wave event, you're going to like it even less in the future." Famously, the chief scientific advisor to the British government, Sir David King, even envisions that an ice-free "Antarctica is likely to be the world's only habitable continent by the end of this century if global warming remains unchecked."

Nearly all discussions of the future impacts of global warming use the 2003 heat wave in Europe as their prime example. In Al Gore's words: "We have already begun to see the kind of heat waves that scientists say will become much more common if global warming is not addressed. In the summer of 2003 Europe was hit by a massive heat wave that killed 35,000 people."

Yet while we will see more and hotter heat waves, talking only about heat waves means we leave out something even more important.

Heat Deaths—Way of the Future?

The IPCC finds that the trends we have seen over the twentieth century will continue, with temperatures increasing more over land, more in the winter, and especially in the high northern latitudes: Siberia, Canada, and the Arctic. In the wintertime, temperatures might increase 9°F in Siberia compared to perhaps 5°F in Africa. There will be an increase in heat waves and a decrease in cold spells. We will see a

marked decrease in frost days almost everywhere in the middle and high latitudes, and this will lead to a comparable increase in the growing-season length.

Models show that heat events we now see every twenty years will become much more frequent. By the end of the century, we will have such events happening every three years. This confirms the prospect that we could be seeing many more heat deaths—a tragedy that will indeed be caused by global warming.

But cold spells will decrease just as much as heat waves increase. In areas where there is one cold spell every three years, by the end of the century such spells will happen only once every twenty years. This means fewer deaths from cold, something we rarely hear about.

In the U.S. 2005 Climate Change and Human Health Impacts report, heat is mentioned fifty-four times and cold just once. It might seem callous to weigh lives saved versus those lost, but if our goal is to improve the lot of humanity, then it's important to know just how many more heat deaths we can expect compared to how many fewer cold deaths.

For almost every location in the world, there is an "optimal" temperature at which deaths are the lowest. On either side of this temperature—both when it gets colder and warmer—death rates increase. However, what the optimal temperature is is a different issue. If you live in Helsinki, your optimal temperature is about 59°F, whereas in Athens you do best at 75°F. The important point to notice is that the best temperature is typically very similar to the average summer temperature. Thus, the actual temperature will only rarely go above the optimal temperature, but very

often it will be below. In Helsinki, the optimal temperature is typically exceeded only 18 days per year, whereas it is below that temperature a full 312 days. Research shows that although 55 extra people die each year from it being too hot in Helsinki, some 1,655 people die from it being too cold.

It may not be so surprising that cold kills in Finland, but the same holds true in Athens. Even though absolute temperatures of course are much higher in Athens than in Helsinki, temperatures still run higher than the optimum one only 63 days per year, whereas 251 days are below it. Again, the death toll from excess heat in Athens is 1,376 people each year, whereas the death toll from excess cold is 7,852.

This trail of statistics leads us to two conclusions. First, we are very adaptable creatures. We live well both at 59°F and 75°F. We can adapt to both cold and heat. Further adaptation on account of global warming will not be unproblematic, because we have already invested heavily in housing and infrastructure such as heating and air-conditioning to handle our current climate. But that is why the second point is so important. It seems reasonable to conclude from the data that, within reasonable limits, global warming might actually result in lower death rates.

Death in Europe

The heat wave in Europe in early August 2003 was exceptional in many ways. It was a catastrophe of heartbreaking proportions. With more than 3,500 dead in Paris alone, France suffered nearly 15,000 fatalities from the heat wave. Another 7,000 died in Germany, 8,000 in Spain and Italy,

and 2,000 in the United Kingdom: the total death toll ran to more than 35,000. Understandably, this event has become a psychologically powerful metaphor for the frightening vision of a warmer future and our immediate need to prevent it.

The green group Earth Policy Institute, which first totaled the deaths, tells us that as "awareness of the scale of this tragedy spreads, it is likely to generate pressure to reduce carbon emissions. For many of the millions who suffered through these record heat waves and the relatives of the tens of thousands who died, cutting carbon emissions is becoming a pressing personal issue."

Such reports fueled the public perception that the heat wave became a sure indicator of global warming. But group wisdom can occasionally be wrong. A recent academic paper has checked this theory and concluded that although the circumstances were unusual, equal or more unusual warm anomalies have occurred regularly since 1979.

Moreover, while thirty-five thousand dead is a terrifyingly large number, all deaths should in principle be treated with equal concern. Yet this is not happening. When two thousand people died from heat in the United Kingdom, it produced a public outcry that is still heard. However, the BBC recently ran a very quiet story telling us that deaths caused by cold weather in England and Wales for the past years have hovered around twenty-five thousand each winter, casually adding that the winters of 1998–2000 saw about forty-seven thousand cold deaths each year. The story then goes on to discuss how the government should make more winter fuel available and how the majority of deaths are caused by strokes and heart attacks.

It is remarkable that a single heat-death episode of thirty-five thousand from many countries can get everyone up in arms whereas cold deaths of twenty-five thousand to fifty thousand a year in just a single country pass almost unnoticed. Of course, we want to help avoid another two thousand dying from heat in the United Kingdom. But presumably we also want to avoid many more dying from cold.

In Europe as a whole, about two hundred thousand people die from excess heat each year. However, about 1.5 million Europeans die annually from excess cold. That is more than seven times the total number of heat deaths. Just in the past decade, Europe has lost about fifteen million people to the cold, more than four hundred times the iconic heat deaths from 2003. That we so easily neglect these deaths and so easily embrace those caused by global warming tells us of a breakdown in our sense of proportion.

How will heat and cold deaths change over the coming century? Let us for the moment assume—very unrealistically—that we will not adapt at all to the future heat. Still, the biggest cold and heat study from Europe concludes that for an increase of 3.6°F, "our data suggest that any increases in mortality due to increased temperatures would be outweighed by much larger short-term declines in cold-related mortalities." For Britain, it is estimated that a 3.6°F increase will mean two thousand more heat deaths but twenty thousand fewer cold deaths. Indeed, a paper trying to incorporate all studies on this issue and apply them to a broad variety of settings both developed and developing around the world found that "global warming may cause a decrease in mortality rates, especially of cardiovascular diseases."

But of course, it seems very unrealistic and conservative to assume that we will not adapt throughout the twenty-first century. Several recent studies have looked at adaptation in up to twenty-eight of the biggest cities in the United States. Take Philadelphia. The optimal temperature seems to be about 80°F. In the 1960s, when it got hotter (about 100°F), the death rate increased sharply. Likewise, when temperatures dropped below freezing, it increased sharply—just like in Athens.

Yet something great happened in the decades following. Death rates dropped in general because of better health care. But crucially, temperatures of 100°F today cause almost no excess deaths. However, more people still die because of colder weather. One of the main reasons for the lowered heat susceptibility is likely increased access to air-conditioning. Studies seem to indicate that over time and with sufficient resources we actually learn to adapt to higher temperatures. Consequently, we will experience fewer heat deaths even when temperatures rise.

Moreover, we have already experienced temperature rises on the scale of what we're expecting over the coming century—in many of the major cities around the world. By the end of the century, the overwhelming majority of the world's population will likely live in cities. Cities have already experienced large temperature increases and thus provide ways for us to peek into the future and get a sense of how bad a 4.7°F increase will be.

Bricks, concrete, and asphalt, which dominate cities, absorb much more heat than vegetation does in the countryside. The effect creates what are called urban heat islands. The British meteorologist Luke Howard originally

discovered the effect in the early 1800s in London, but as cities grow and replace ever more vegetation with high-rises and tarmac, we have seen the effects documented in cities around the world—from Tel Aviv, Baltimore, and Phoenix to Guadalajara in Mexico, Barrow in Alaska, Shanghai, Seoul, Milan, Vienna, and Stockholm. In downtown Los Angeles, maximum temperatures over the past century have increased some 4.5°F and minimum temperatures some 7°F. New York has a similar nighttime urban heat island of 7°F.

Recently, we have been able to use satellite measurements of the temperatures of the entire surface of a city. In looking at Houston, a fast-growing city—from 1990 to 2000, it grew by three hundred thousand residents, a full one-fifth increase—researchers found an amazing result. Over a short twelve years, the nighttime surface temperature increased about 1.4°F. Over a one-hundred-year period, that would translate into an increase of more than 12°F.

And indeed, these are the kinds of temperature differences that are being found for huge cities around the world. Asian cities are today the most rapidly growing regions of the world. Tokyo, with its twenty million inhabitants, has seen some of the most dramatic consequences of the urban heat island. While the daytime temperature of the area surrounding Tokyo in August was 83°F, the downtown was measured at above 104°F. And this high temperature is not just affecting a small inner core of the city—the high-temperature area covers some three thousand square miles, or the equivalent of 140 times the area of Manhattan. These worldwide urban temperature increases tell us at least two things.

First, many of these increases over the past half or full century are on the same order or bigger than the 4.7°F that we expect to see over the coming full century. It is likely that for many cities the urban-heat-island increases of the twentieth century are on a larger scale than those to come from global warming in the twenty-first century. Yet the increases have not brought these cities tumbling down.

This does *not* mean that such increases might not have been bad for many cities. Although deaths have in general been declining (as in Philadelphia), they might have declined even faster without it. But it means that the doomsday predictions are not objective when they fail to account for the adaptation that will possibly strongly mitigate the temperature effects. Since our forebears were able to do so, it seems reasonable to assume that, being much richer and having vastly more technical prowess, we will be able to repeat their feat.

This also does *not* deny that with global warming the impact on cities will be considerably worse because they will be hit by a double whammy—temperature increases both from CO_2 and from still increasing urban heat islands. But unlike previous generations who did very little or nothing about urban heat islands, we are in a good position to alleviate many of their effects. Presumably our goal is to prevent part of the problems of increasing temperatures over the coming century.

Studies show that very simple solutions can make great differences. One of the two main reasons cities are hotter is that they are drier. Cities lack moist green spaces and have large impermeable surfaces with drainage that quickly leads any water away. Thus, the sun's energy goes into heating the atmosphere instead of into the cooling evaporation of water. If we plant trees and provide vegetation and water features in urban environments, this will—apart from making more beautiful cities—dramatically cool the surroundings. For London, that could decrease temperatures by more than 14°F.

The other main reason that cities are hotter is that they have a lot of black asphalt and heat-absorbing dark structures. Although it may seem almost comically straightforward, one of the main solutions is very simple: paint the tarmac and buildings white. Increase the general reflectivity and natural shading from buildings, and we can avoid a great deal of the heat buildup. In London, this could lower heat by 18°F.

Real-world political suggestions focus on "cool communities," reroofing and repaving in lighter colors as well as planting trees. Such a program for Los Angeles—involving planting eleven million trees, reroofing most of the five million homes, and painting one-quarter of the roads—would have a onetime cost of about $1 billion. However, it would have *annual* added benefits of lowering air-conditioning costs by about $170 million and providing $360 million in smog-reduction benefits—plus the added benefits of a greener city. And perhaps most impressive, it would lower city temperatures by more than 5°F—or about the temperature increase envisioned for the rest of this century.

The Kyoto Protocol: Buying Seven Days

But even though temperature rises may not be as devastating as people think, and even if there are other, cheap ways

to deal with much of the temperature increase, is it still not also obvious that we want to cut CO_2 emissions?

Well, maybe. It really depends on how much good we can accomplish and at what cost. Let's look at this more closely.

At the moment, the only real political initiative calling for carbon cuts is the so-called Kyoto Protocol, signed in 1997. It has been championed by many environmentalists, including Al Gore, who as vice president directed the U.S. negotiations. Here it was decided that the industrial nations should reduce their overall CO_2 emissions in the period from 2008 to 2012 by about 20 percent below what they would otherwise have been.

Yet Kyoto matters little for the climate. Even if all countries had ratified it (the United States and Australia did not), and all countries lived up to their commitments (which many will have a hard time doing) and stuck to them throughout the twenty-first century (which would get ever harder), the change would have been minuscule. The temperature by 2050 would be an immeasurable 0.1°F lower and even by 2100 only 0.3°F lower. This means that the expected temperature increase of 4.7°F would be postponed just *five* years, from 2100 to 2105.

Given the centrality of Kyoto in the public discourse, it surprises most people to learn how little its adoption would actually change the future. It is worth emphasizing that these data are scientifically entirely uncontroversial. The five-year postponement over one hundred years is derived from work by one of IPCC's foremost modelers. This is why *The Washington Post* calls Kyoto a "mostly symbolic treaty." Even its staunchest backers admit Kyoto is only a small first

step, and we are routinely told that we need to get much more ambitious.

Since 1997, the United States and Australia have dropped out. Countries including Canada, Italy, Portugal, and Spain are off track to meet their commitments. At the same time, Russia and other low-performing transition economies are allowed to emit much more than they do, which means that they can sell their excess emissions rights. In total, this means that Kyoto really no longer restricts CO_2. Realistically, the effective outcome will be a tiny 1 percent reduction of industrial-country emissions from what they would otherwise have been.

If no other treaty replaces Kyoto after 2012, its total effect will have been to postpone the rise in global temperature a bit less than seven days in 2100.

Why is the effect of cutting emissions so little? The answer is that the emissions from the developed world matter less and less as China, India, and other developing countries dramatically grow their economies. Yet neither China nor India seems likely to accept real limits anytime soon, basically because they have other and bigger priorities, such as food and improved living conditions. Lu Xuedu, deputy director of China's Office of Global Environmental Affairs, pointed out: "You cannot tell people who are struggling to earn enough to eat that they need to reduce their emissions." We will get back to that point.

But still, even if we reduce temperatures only a little, is that not better than doing nothing? Perhaps, but before deciding let us look at the cost.

Cost of Cutting Carbon

In estimating the cost of Kyoto, the largest assembly of the top macroeconomic models shows an average cost of about $180 billion annually from 2008. While this cost would definitely not bankrupt the industrialized world, it is still a significant amount—about 0.5 percent of global GDP. Of course, with the United States out, the cost is lower, and the effect is dramatically lower. Depending on Russia and the future of negotiations, models estimate costs as low as $5 billion to $10 billion, or nearly as high as $180 billion.

Often, people ask: Why does it cost to cut CO_2? Well, there are many different ways that cutting carbon can be costly.

Oil by itself is the most important and most valuable commodity of international trade. At more than $1.5 trillion per year, it alone accounts for more than 3 percent of global GDP. With gas and coal, fossil fuels make up more than $2.5 trillion, or 5.5 percent of global GDP. Consequently, there is big money to be made by saving energy, and incremental smart ideas in a myriad of companies and organizations every year shave off about a percent of our energy use. Actually, at least as far back as we have statistics, we have learned to produce ever more goods with the same amount of energy. Whereas the United States in 1800 produced only one present-day dollar's worth of output for a unit of energy, it today produces almost five dollars' worth.

Although a large part of the energy-efficiency increase takes place in industry and organizations, we also experience the effect as consumers. The average car driven in America has improved its mileage by 67 percent since 1973. Likewise, home heating in Europe and the United States has improved 24 to 43 percent. Many appliances have become much more efficient—the average dishwasher, washing machine, and air conditioner have cut about 50 percent of their energy use over the past decades.

This by itself should lead us to believe that we would use less and less energy. But while the car's engine gets more efficient, we get a car with air-conditioning. While our washing machine uses less energy, we also buy a dishwasher. We heat each room more efficiently but have ever more space. While we produce each dollar's worth of goods ever more efficiently, we produce even more worth. Ingenuity still works, and people constantly find ways to cut energy use—if they didn't, our energy consumption would increase 75 percent more over the next fifty years—but our total energy consumption increases, and so do our carbon emissions.

Thus, if we want to cut emissions beyond what comes from natural ingenuity, we need to motivate people to emit less. Here, economists advocate using a tax on carbon. While nobody likes taxes (maybe apart from the secretary of the Treasury), they send a powerful signal to avoid or at least lessen carbon emissions. If you have to pay more, you will probably cut back on some of your energy consumption—maybe you will switch off the air conditioner in the car, or possibly you will even bike.

More important is what happens to industry, power plants, and heating facilities, which cause the majority of emissions. Coal is cheap but emits lots of carbon, whereas gas is more expensive but emits less, and renewables, such as biomass and solar energy, are even more expensive but

DOESN'T CUTTING EMISSIONS SAVE MONEY?

It is often claimed that we can cut emissions and actually make money. For instance, in your own home, you could lower the heat and put on a sweater or unplug some of your gizmos when they are not being used. In a recent global-warming awareness week in the United Kingdom, Tony Blair pledged to turn down his thermostat, while Sir David Attenborough promised to unplug his cell phone charger. Isn't this costless or even advantageous? After all, cutting your heating or electricity bill means money in your pocket.

Economists are typically wary of such claims. Why, they ask, would you not have done so if it really already was in your own interest to do so? Why would Sir David have to wait till the awareness week to pledge to unplug his charger if it had been an advantage for him to do so all along? This is reminiscent of Japan's Ministry of the Environment trying to catch up to the Kyoto greenhouse-gas targets by turning off the heat in February 2006:

> The ministry's "Warm Biz" campaign urges Japan's bureaucracy and businesses to bundle up with sweaters and scarves to cut down on energy use. "It's actually not that cold. We're all keeping warm from the heat of our computers," ministry spokesman Masanori Shishido said, but admitted he has taken to wearing thermal underwear.

Likewise, we are often told about a range of energy-efficiency home improvements that we rarely do but that would actually make us money. Again, the economists wonder why we didn't already do them if they are so beneficial. For instance, engineers and manufacturers claim that insulating your house would reduce the energy bill by 22 to 53 percent. An academic study found that the advertised savings were vastly overstated, thus explaining many home owners' reluctance. In the United Kingdom, a well-known environmental architect campaigns to get people to add a near-silent microwindmill to the gable ends of their houses. At a cost of one thousand pounds and a promise of saving up to 50 percent of a household's electricity demand, it seems like a good deal. However, an independent analysis found that such a windmill would typically produce only about 5 percent of a household's electricity—one-tenth the promised amount.

emit no CO_2. With a carbon tax, businesses will tend toward cleaner but more expensive energy sources or toward processes that are more complicated but use less fuel.

This explains why cutting carbon will have real cost. It is not the tax in itself—after all, the money from taxes will be used for the public good, perhaps even for allowing other taxes to be cut. But the fact that businesses will have to use more expensive fuels or find more expensive work-arounds means that the same products and services will now be more expensive—a cost that will ultimately be borne by us, as consumers. Now, there is nothing inherently wrong about this. Since CO_2 actually does harm, you could argue that the prices before the tax didn't reflect this harm. Or to put it differently, the extra cost we pay should be compared to the environmental benefit that we receive in less global warming. This perspective is worth contemplating.

Costs and Benefits—the Value of a Ton of CO_2

Scientists, lobbyists, and politicians will tell you that we should try to solve all the world's problems—not just climate change but all the world's woes. Nevertheless, we don't. Likewise, it is often pointed out that "we have the technology" to fix much of global warming. This is true. But we also have the technology to go to the moon, yet we don't go very often. It is too expensive.

So if we don't have (or use) the resources to fix all our problems, we should think about priorities. It is obvious that we should do something about CO_2 emissions and equally obvious that we can't cut all of them—because

doing so would essentially bring our society to a halt and end civilization as we know it.

One way to think about this question is to ask about one of the next tons of CO_2 we are about to put into the atmosphere. How much harm will that ton do? And how cheaply can we avoid it?

Over the next year, two soccer moms will drive their kids back and forth to school and emit a ton of CO_2. One hundred twenty-five people are going to leave their cell-phone chargers plugged in 24-7 (though presumably not David Attenborough) and over the year cause the utilities to emit an extra ton of CO_2. Three people will have hot showers for four minutes each day and add an extra ton of CO_2 to the atmosphere. In addition, many industrial and commercial processes that most of us don't even know exist will add their tons as well.

The question then is, Which ton should we cut first? That is a hard one. Maybe the soccer moms should walk? Maybe we should get the 125 guys to unplug their chargers, but how do we organize that? This is the magical part about a carbon tax—we don't actually have to find out who should cut their emissions first. Instead, the people who have the least to lose will step up first.

If we place a tax of one dollar on a ton of CO_2, gasoline will go up about one cent a gallon. Each of the soccer moms will have to pay fifty cents more each year to drive their kids to school. The electricity bill will go up, and the 125 guys will collectively pay one dollar for their cell chargers, or a little less than a cent extra each. And to shower, you will have to pay thirty-three cents extra. Now, we don't know which of these people will change their behavior slightly—

or even if anyone will. But we know that there are some people who will. Chances are they will come from industry, because a cent per gallon when you use lots gets your attention sooner.

A one-dollar tax on CO_2 will actually lead to an overall drop in emissions of a bit more than 2 percent. Remember this is over and above the 1 percent efficiency improvement that every year comes from smarter ways to use energy (the "free" reduction). So we can cut emissions. We actually have a very simple and efficient knob to turn emissions down. The temptation is to say: Why don't we turn the knob all the way up—with a thirty-dollar tax we can cut almost 40 percent?

But cutting emissions also has costs. As we saw above, industries will have to switch to more expensive fuels or more expensive procedures. Taking a shorter shower also has a cost, although in a more indirect sense. If your cost of a hot shower is ten cents per minute, after judging your finances and your preferences you might have settled on a daily four-minute shower. If a carbon tax increases this cost, you might end up deciding that you will only do three minutes instead of four. We will have gotten a CO_2 reduction, but you will also be less pleased—you will have forgone a minute under the shower that you previously judged to be worth ten cents.

In a global macroeconomic model, the total present-day cost for a permanent one-dollar CO_2 tax is estimated at more than $11 billion. So we might want to think twice about cranking up the knob to a thirty-dollar CO_2 tax, which will cost almost $7 trillion.

Essentially, the cost of turning the knob should somehow

be weighed against the benefits of less global warming. There are two ways of thinking about this, leading to somewhat the same result. We will look at cost-benefit later, but first we could think of CO_2 as pollution.

Pollution is a negative by-product of many activities. The activity itself is valuable to us, but the pollution causes problems for others. The difficulty is that we don't take these problems into account when making decisions about our activity—after all, they are not *our* problems. But if we had to pay for the damage, then those problems suddenly *would* become our problems. This is the idea behind the "polluter pays" principle. If we have to pay the price of the problem we cause, it will not necessarily mean that we will stop everything we do—after all, the activity was also valuable—but we will be forced to weigh it against the damage it will cause, and we will only make things that will do more good than harm.

This means that we must figure out the price of CO_2. How much damage does the next ton of CO_2 that you send into the atmosphere do? This is a daunting question with no definitive answer. But over the past ten years, some of the world's top natural scientists and economists have come up with a broad range of assessments that yield a fair amount of insight.

In the biggest review article of all the literature's 103 estimates, the climate economist Richard Tol makes two important points. First, the really scary high estimates typically have not been subjected to peer review and published. In his words: "Studies with better methods yield lower estimates with smaller uncertainties." Second, he finds that

with reasonable assumptions the cost is very unlikely to be higher than fourteen dollars per ton of CO_2 and likely to be much smaller. When I specifically asked him for his best guess, he wasn't too enthusiastic about shedding his cautiousness—true researchers invariably are this way—but gave a best estimate of two dollars per ton.

This means that the damage we will cause by putting out one more ton of CO_2 is likely two dollars and very unlikely to be higher than fourteen dollars. Consequently, we would do best to put a two-dollar tax on CO_2 to make sure that we properly take into account the damage we cause from using fossil fuels. If we don't have a carbon tax, we end up thinking that we can pollute with CO_2 for free, even though each ton does two dollars' or more worth of damage. But likewise, we shouldn't overtax CO_2. If we tax it at $85, as proposed in one radical report, while the real damage is two dollars, we lose up to $83 of social benefits. This is no trivial loss—the myriad lost opportunities add up to a total one-time economic cost of more than $38 trillion. This is more than three times the annual U.S. GDP.

So setting the tax right matters. If we put it too low, we emit too much CO_2; if we put it too high, we end up much poorer without doing enough good. A crucial question, then, is the cost of cutting CO_2 under Kyoto. For the United Kingdom, the marginal cost is estimated at twenty-three dollars per ton of CO_2—between two and eleven times higher than the likely cost of climate change.

The Kyoto Protocol turns out to be too expensive compared to the good it does. We end up spending fairly large amounts of resources (up to twenty-three dollars per ton of

CO_2 averted) but doing only little good. Could we perhaps have done more good for the world with those twenty-three dollars elsewhere? The answer is yes.

Costs and Benefits of Climate Action

Most of us don't usually buy a ton of CO_2, and thus it is a bit hard to intuit whether two or twenty-three dollars is cheap or expensive. Moreover, if we were going to cut only a couple of tons, the cost probably wouldn't matter one way or the other. But as we are talking about cutting millions and even billions of tons, maybe it would make more sense to talk in total costs and total benefits. This would have the added strength of making this choice much more comparable to other choices. As participants in a democratic process, we routinely do make (collective) choices to spend billions of dollars on many public goods, including education, health, roads, and foreign aid.

The models that estimate the total costs and benefits of global warming have been around since the early 1990s, and according to the IPCC they all produce more or less the same substantial results. What is unique about these models is that they include both a climate system and an economic system, with costs to the economic system stemming from both climate changes and CO_2 cuts.

These integrated models try to incorporate the costs of all the different impacts from climate change, including those on agriculture, forestry, fisheries, energy, water supplies, infrastructure, hurricanes, drought damage, coastal protection, land loss (caused by a rise in sea level—as in Holland, for example), wetlands, human and animal survival, pollution, and migration. Costs are expressed as the sum of two quantities: the costs of adaptation (building dams, changing to other crops, and so on) and the costs we must incur from the remaining nonadapted consequences (not all land is saved by building dams; production may fall despite the introduction of new crops; and so on).

So we have a model that can take any CO_2 policy and show us *both* the economic cost of CO_2 cuts *and* the benefits (the avoided damage) from lower temperatures on agriculture, wetlands, human life, and more. This means that we can see both the costs and benefits of the Kyoto Protocol and of more stringent regulations. We can then ask, What would be the best strategy for confronting global warming?

For the full Kyoto Protocol with the United States participating, the total cost over the coming century turns out to be more than $5 trillion. There is an environmental benefit, from the slightly lower temperature toward the end of the century: about 0.3°F. The total benefit for the world comes to almost $2 trillion. Yet in total, this shows that the Kyoto Protocol is a bad deal: for every dollar spent, it does the world only about thirty-four cents' worth of good.

Perhaps tellingly, it turns out that the United States would have borne the highest cost, at almost $6 trillion, with almost trivial benefits, which by itself might explain why the United States was the least engaged party. The same pattern repeats itself for Canada and Australia, with large costs and small benefits.

Conversely, Europe has the best deal of the rich world, paying $1.5 trillion but getting almost half back in benefits. It is still not a good deal but certainly goes a long way to

explain why Europe has been the most prominent backer of Kyoto.

Russia and the other transition economies would have benefited greatly from Kyoto, because they could have sold their emissions permits at a high price, to the tune of almost $3 trillion. Of course, when the time came for Western countries to pay up, it seems politically unlikely that the public in either Europe or the United States would have accepted annual transfers of more than $50 billion for what is essentially hot air.

Finally, with a net benefit of $1.4 trillion, the rest of the world is somewhat better off, with a little less than half accruing to the lowest-income countries. This benefit, however, has to be seen in the context of the rich world forking out almost $9 trillion. For every dollar spent, the rich countries do about sixteen cents of good in the developing world.

With the United States out of Kyoto, the models show that there is not much left. Essentially, Europe, Japan, and New Zealand pay $1.5 trillion, most of which will buy hot air, and a little that will buy an extremely tiny temperature change of 0.07°F by 2100.

It is perhaps worth noticing that all of the costs and benefits above assume that policies are implemented globally and efficiently—that the smartest policies are used and coordinated globally, given the required reductions. Thus, should the rich countries not use Russia's extra quotas, the costs could escalate to almost double with virtually no added benefit. And it requires that policy makers cut CO_2 where it is absolutely cheapest—if not, the total cost has essentially no upper limit. In the United Kingdom, the

Kyoto CO_2 tax ought to be about five dollars per ton after the United States has left. However, the United Kingdom requires electricity generators to supply 10 percent of its electricity from certified renewable sources, under the so-called Renewables Obligation. Currently, that cost is estimated at $169, or more than thirty times too expensive. And remember that the Kyoto tax is probably too high compared with the CO_2-damage cost of about two dollars per ton. Thus, for every dollar spent on the Renewables Obligation, the United Kingdom gets three cents back on its Kyoto promise and does about one penny's worth of good.

When confronted with the point that doing Kyoto is an extraordinarily expensive way of doing very little good far into the future, many react by saying we should do much more. But doing more of a bad deal is rarely smart, and the models show us just that. Cutting more carbon is likely to cost ever more while doing ever less extra good. And it is still worth remembering that the cost assumes politicians will choose the very smartest tools available.

That cutting more gets ever more costly also makes good intuitive sense. If we cut a little, it is easy—surely anything you do could be improved relatively cheaply to emit a little less CO_2. The metaphor is that we pick the low-hanging fruit first, which is easily accessible. However, as we try to cut more and more, it will get ever more expensive—we have to reach high into the tree for the remaining, scarce fruit. Also, the first cuts we make mean we cut into the highest, most scary part of the temperature increases. As we cut ever deeper, we will start to cut into more usual temperatures. So while the cost increases with deeper cuts, the benefit decreases.

This is evident when we move from Kyoto to some of the more ambitious policies contemplated. Stabilizing the temperature increase to 4.5°F does more good—it reduces temperatures 0.86°F—but at a rather high cost of $15.8 trillion. It is instructive to compare this to the total cost of global warming. Models show that if global warming wasn't happening, the world would end up about $14.5 trillion richer. Thus, the cost of global warming can be estimated at $14.5 trillion. Stabilizing the temperature increase at 4.5°F actually means we end up paying more for a partial solution than the cost of the entire problem. That is a bad deal.

The most ambitious plan is to stabilize the temperature rise at 2.7°F. This is essentially the stated preference of the EU. The EU has reconfirmed this decision over the last many years. One central model shows it is possible to achieve such very low temperature increases, but only at the formidable cost of $84 trillion. For every dollar spent, it will do thirteen cents' worth of good.

Actually, the models also show a reduction that does more good than it costs. This initiative sets a global carbon tax that balances with the future environmental benefits from CO_2 cuts. It starts off with a carbon tax around two dollars per ton, rising to about twenty-seven dollars at the end of the century, reflecting how damages rise with more CO_2 in the atmosphere. The total climate impact is rather small—it only reduces the temperature increase by 0.2°F by the end of the century. Uniquely, it costs about $600 billion but creates twice that in benefits, meaning for each dollar it does two dollars of social good.

This result is surprising and runs counter to most of the climate-change proposals. We try to cut CO_2 through Kyoto,

but in reality it is a poor use of resources. Many, including the EU, think we need to go much further, but the economic models show us that this is likely to be an even poorer use of resources. In general, this shows that we need to be very careful in our willingness to act on global warming. Going much beyond the small optimal initiative is economically unjustified. And this conclusion does not come from the output just of a single model.

All major peer-reviewed economic models agree that little emissions reduction is justified. A central conclusion from a meeting of all economic modelers was: "Current assessments determine that the 'optimal' policy calls for a relatively modest level of control of CO_2." In a review from 2006, the previous research was summarized: "These studies recommend that greenhouse-gas emissions be reduced below business-as-usual forecasts, but the reductions suggested have been modest."

This is such a robust result because the economic cost comes up front, whereas the benefit comes centuries down the line. If we try to stabilize emissions, it turns out that for the first 170 years the costs are greater than the benefits. Even when the benefits catch up in the late twenty-second century, there is still a payback time before the total benefits outweigh the total costs, around 2250. Thus, as one academic paper points out, "the costs associated with an emissions stabilization program are relatively large for current generations and continue to increase over the next 100 years. The first generation to actually benefit from the stabilization program is born early during the 24th century." If our desire is to help the many generations that come before then, along with the world's poor, if cutting emissions is not

the best way. Perhaps more surprisingly, cutting emissions is also not the best way to help people in the twenty-fourth century, since we could have focused on solving many other immediate problems that would leave the far future much better off.

We clearly need smarter ways to deal with climate change.

Living in a Hotter World

But of course, all this economist talk doesn't help if the whole world collapses. If many or most of the planet's inhabitants die from increased heat deaths, what does it matter that lower taxes are cheaper?

As it turns out, such understanding is widespread, but the threat is vastly exaggerated. And not just for the United Kingdom, as we saw above. The first complete survey for the world was published in 2006, and what it shows us very clearly is that climate change will not cause massive disruptions or huge death tolls. Actually, the direct impact of climate change in 2050 will mean *fewer* dead, and not by a small amount. In total, about 1.4 million people will be saved each year, due to more than 1.7 million fewer deaths from cardiovascular diseases and 365,000 more deaths from respiratory disorders. This holds true for the United States and Europe (each with about 175,000 saved), as for the rest of the industrialized world. But even China and India will see more than 720,000 saved each year, with deaths avoided outweighing extra deaths nine to one. The only region where deaths will outweigh lives saved is in the rest of the developing world, especially Africa. There almost

200,000 deaths will be avoided, but more than 250,000 will die.

The reaction of both my editor and several of my friends on reading this chapter was telling—and perhaps also similar to your reaction: Yes, but what happens after 2050—will heat deaths not eventually begin outweighing avoided cold deaths? It is a good question. But the survey shows that the result doesn't hold true just in 2050: in the central estimates of the model, *lives saved will continue to outweigh extra deaths when counting both cardiovascular and respiratory diseases at least till 2200.* So the simple answer to the question is no, heat deaths will not outweigh avoided cold deaths, not in 2050, 2100, or even 2200.

But it is just as important that you (well, certainly my friends and my editor) instinctively felt the need to question the claim that global warming will have positive impacts. We do not seem to have the same inquisitiveness when we're told about negative impacts. We will get back to this when discussing malaria.

Now we can also answer what we can and should do. Many commentators point out how global warming will hit the developing world hardest. For deaths from heat and cold, this is true. But most commentators then go on to suggest that we should cut carbon emissions, possibly dramatically, to help the third world. This, however, turns out to be very questionable advice.

If we got everyone on board for Kyoto, including the United States, we would see reduced temperatures in 2050 by about 0.1°F, or a postponement of temperature increases by less than three years. Thus, the developing world would

experience slightly less warming by 2050. Outside of China and India, the consequence would be about 6 percent fewer deaths from respiratory disorders, saving more than fifteen thousand lives per year that would otherwise have ended. This seems to confirm that CO_2 reductions are the way to go.

But first, we have to remember that the world would pay about $180 billion annually for fifty years before this benefit would occur. Roughly that means paying almost $100 million for each life saved, which is much more than what we pay to save lives in the developed world and certainly vastly more expensive than what lives can be saved for in the developing world—estimated at less than two thousand dollars.

Second, we have to remember that cutting CO_2 and temperature means more people will die from cold deaths in the developing world—more than eleven thousand annually. So in reality, we have saved only a little fewer than four thousand people (now at the price of $300 million each).

Third, we cannot just change the thermostat where temperature impact is on the whole negative. We also end up changing it in all the other places—in the United States, Europe, Russia, China, and India. Here the effect of Kyoto on lives lost directly from temperature impacts would mean an increase in deaths of about 88,000 annually. Thus, to save four thousand people in the developing world, we end up sacrificing more than $1 trillion and eighty thousand people. Bad deal.

Global Warming Is Not the Only Issue

This does *not* mean that we should do nothing and just embrace global warming. We have looked at just one aspect: direct impacts from temperature. There are other issues, which we will discuss later, in which general and long-term impacts will be more negative.

But this aspect tells us three things, loud and clear. First, our understanding of global warming as shaped by the media and the environmental pundits is severely biased. We are being told by respected scientist James Lovelock that with the coming climate-change devastation the thirty-five thousand dead in Europe in 2003 was just the prelude to a new Stone Age: "Before this century is over billions of us will die and the few breeding pairs of people that survive will be in the Arctic where the climate remains tolerable." This is far beyond the pale of our understanding of climate change. And getting the facts wrong means we may make staggeringly bad policy judgments.

Second, when we talk about global warming, we seem obsessed with regulating just one parameter—namely, CO_2. But while turning down the CO_2 knob may be part of the solution, surely our primary concern ought to be to advance human and environmental well-being the most, where many other knobs are in play. While cutting CO_2 will save some people from dying of heat, it will simultaneously cause more people to die from cold. This highlights how reducing CO_2 means indiscriminately eliminating both negative and positive effects of global warming. We ought at least to consider adaptive strategies that would allow us to

hold on to the positive effects of climate change while reducing or eliminating its damages.

Third, global warming is not the only issue we need to tackle. This especially holds true for the third world. Take a look at the World Health Organization's estimates of what kills us. WHO finds that climate change kills about 150,000 people in the developing world now, but as we will see in the section on malaria below, they failed to include avoided cold deaths, so this estimate is vastly overstated.

Nevertheless, it is obvious that there are many other and more pressing issues for the third world, such as almost four million people dying from malnutrition, three million from HIV/AIDS, 2.5 million from indoor and outdoor air pollution, more than two million from lack of micronutrients (iron, zinc, and vitamin A), and almost two million from lack of clean drinking water.

Even if global warming exacerbates some of these problems (as we will discuss), it is important to point out that the total magnitude of the problems is likely to far exceed the extra problems caused by climate change. Thus, policies reducing the total problem will benefit many more people than policies that only reduce the small additional part caused by global warming. Again, are there better ways to help than by cutting CO_2?

We have to ask ourselves, What do we want to do first? This is a question I have been deeply involved in answering through a process called the Copenhagen Consensus. We asked some of the smartest economists in the world, Where do extra resources do the most good first? For each problem, we asked experts to put forward the very best solutions. With global warming, this might be CO_2 taxes or Kyoto, whereas for malnutrition it might be agricultural research, and for malaria it could be mosquito nets. But each expert didn't just state that the solutions do good—they showed just how much good they would do and how much they would cost.

In essence, the experts assessed the dollar value of different solutions, just as we saw them doing for climate. In that case, they estimated the benefit of Kyoto for each of the positive impacts on agriculture, forestry, fisheries, water supply, hurricane damage, and so on. They estimated the costs through losses in production. For malaria solutions, the positive effects would be the value of fewer dead, fewer sick, fewer absences from work, more robust populations with respect to other diseases, and increased production. The costs would be the dollar amount spent on buying, distributing, and using mosquito nets.

A panel of top-level economists, including four Nobel laureates, then made the first explicit global priority list ever, shown in table 1. It divided the world's opportunities into "very good," "good," and "fair" according to how much more good they would do for each dollar spent. "Bad" opportunities were those where each dollar would do less than a dollar's worth of good.

Some of the top priorities also correspond to some of the top risk factors identified by WHO. Preventing HIV/AIDS turns out to be the very best investment humanity can make: each dollar spent on condoms and information will do about forty dollars' worth of social good (the value of fewer dead, fewer sick, less social disruption, and so on). For

	CHALLENGE	OPPORTUNITY
VERY GOOD OPPORTUNITIES	1 Diseases	Control of HIV / AIDS
	2 Malnutrition	Providing micronutrients
	3 Subsidies & Trade	Trade liberalization
	4 Diseases	Control of malaria
GOOD OPPORTUNITIES	5 Malnutrition	Development of new agricultural technologies
	6 Sanitation & Water	Small-scale water technology for livelihoods
	7 Sanitation & Water	Community-managed water supply and sanitation
	8 Sanitation & Water	Research on water productivity in food production
	9 Government	Lowering the cost of starting a new business
FAIR OPPORTUNITIES	10 Migration	Lowering the barriers to migration for skilled workers
	11 Malnutrition	Improving infant and child nutrition
	12 Malnutrition	Reducing the prevalence of low birth weight
	13 Diseases	Scaled-up basic health services
BAD OPPORTUNITIES	14 Migration	Guest workers programs for the unskilled
	15 Climate	Optimal carbon tax ($25–$300)
	16 Climate	Kyoto Protocol
	17 Climate	Value-at-risk carbon tax ($100–$450)

TABLE 1 Global priority list for spending extra resources, from the 2004 Copenhagen Consensus.

$27 billion, we can save twenty-eight million lives over the coming years.

Malnutrition kills almost four million people each year. Perhaps even more dramatically, it affects more than half the world's population, by damaging eyesight, lowering IQ, reducing development, and restricting human productivity. Investing $12 billion could probably half the incidence and death rate, with each dollar doing more than thirty dollars' worth of social good.

Ending first-world agricultural subsidies and ensuring free trade would make almost everyone much better off. Models suggest that benefits of up to $2.4 trillion annually would be achievable, with half of that benefit accruing to the third world. In achieving this, it would be necessary to pay off first-world farmers, who are used to the benefits of a closed market, but the benefits of each dollar would do more than fifteen dollars' worth of social good.

Finally, malaria takes more than one million lives each year. It infects about two billion people every twelve months (many several times) and causes widespread debilitation. Yet an investment of $13 billion could cut its incidence by half, protect 90 percent of newborns, and cut deaths of children under five by 72 percent. For each dollar spent we would do at least ten dollars' worth of social good—a compellingly sound investment, especially when so many of the lives saved would come from nations that carry the weight of the world's greatest problems.

At the other end of the spectrum, the Nobel winners placed climate-change opportunities, including Kyoto, at the bottom under the heading "bad opportunities," underlining what we saw above—namely, that for each dollar

spent, we would end up doing much less than a dollar's worth of good for the world.

But the Copenhagen Consensus did not just ask top economists their opinions. After all, economists (fortunately!) don't lead the world. We asked future leaders—eighty college students from all over the world, with 70 percent from developing countries, with equal gender representation, and from the arts, sciences, and social sciences—what they thought. After five days of meeting with world-class experts on each of the ills, these bright young minds came to a surprisingly similar result. They placed malnutrition and communicable diseases on top, climate change next to last.

In 2006, we ran the project again, asking a wide range of UN ambassadors to make their priority list. Besides the three biggest countries—China, India, and the United States—countries as diverse as Angola, Australia, and Azerbaijan participated, along with Canada, Chile, Egypt, Iraq, Mexico, Nigeria, Poland, Somalia, South Korea, Tanzania, Vietnam, Zimbabwe, and many others.

Politicians don't really like to make choices—they don't like to pick between two groups: they'd rather pretend they can do it all. After I briefed the ambassadors, several of them looked down the list of major challenges facing the planet and said, "I want to put a number one by each of these projects." But prioritize they did. They came out with a list similar to the economists', placing communicable diseases, clean drinking water, and malnutrition at the top, with climate change toward the bottom.

This should make us pause. None of these forums has said that climate change is fictitious or not important. What

they've done is ask us to consider addressing the real and pressing needs of current generations that we can solve so easily and cheaply before we try to tackle the long-term problem of climate change, which will be massively expensive and accomplish so little.

Of course, it's tempting for us to say we should do it all. Morally, that seems compelling. But the truth is that's not realistic. The world lacks the resources and will to solve all its major challenges. Focusing on some issues puts others on the back burner.

These forums also point out that in addressing these immediate problems we do more than just fix the problems of today. Imagine dramatically reducing HIV/AIDS and malaria. Picture a world where more than half the world's population doesn't succumb to developmental deficiencies from malnutrition. Envision a time when rich world agriculture isn't heavily subsidized, actually allowing the third world to sell its products in first-world markets. This is a world I would like to live in. It would not just give communities an immediate boost but also would leave them strengthened, with economies growing faster, meaning still stronger and richer societies by 2100. It will enable these societies to deal much better with future problems—be they natural or from global warming. Investing in today will not only alleviate today's problems but also improve tomorrow.

When we look into the future, the UN expects that people in both the developed and developing countries will become richer. In the industrialized world, people will see their incomes grow sixfold, as we saw during the last century. Income in the developing countries is expected to soar twelvefold.

This is important when talking about climate change. In the UN's most likely scenario for 2100, when many of warming's problems will be felt in earnest, the average person in the developing world is expected to make about one hundred thousand dollars (in present value) each year. Even the very worst-case scenario envisions the average person making above $27,000. In this very unlikely case, the average person in the third world will be as rich as a present-day Portuguese or Greek or richer than most West Europeans in 1980. Much more likely, he or she will be richer than today's average American, Dane, or Australian. This richness will of course enable these countries to better handle outside shocks, whether they come from climate change or any of the other major challenges the future undoubtedly will deal us.

And this is the final part of the reason Nobelists, youngsters, and UN ambassadors place disease and malnutrition so high and climate so relatively low. When we try to help the developing world by cutting our carbon emissions, we are trying to help people far into the future, where they will be much richer. We are not helping a poor Bangladeshi in 2100 but much more likely a rather rich Dutchman. And in case you wonder whether global warming will mean that Bangladesh will be underwater in 2100, we will see below that a rich Bangladesh will lose only 0.000034 percent of its present dry-land area.

The question then becomes whether we wouldn't do better by helping a poor Bangladeshi today. He or she needs our help more, and we can do much more for him or her. Helping a present-day Bangladeshi become less sick, better fed, and better able to participate in the global marketplace will not just do obvious good. It will also enable him or her to better Bangladeshi society, grow the Bangladeshi economy, and leave a richer and more robust Bangladesh to future generations, who will be much better equipped to deal with global warming. To me, that's a compelling case for action.

Our Generational Mission

Yet it is clear that many people in the developed world feel differently. In one recent survey in Australia, environmental concern came in as absolutely the most important priority for the leaders of the world, before eliminating poverty or dealing with terrorism, human-rights issues, and HIV/AIDS. In another survey, the United States, China, South Korea, and Australia found improving the global environment a more important foreign-policy goal than combating world hunger. South Korea put it first on its list of the top sixteen global threats.

Why are we so singularly focused on climate change when there are many other areas where the need is also great and we could do so much more with our effort?

Al Gore gives us two reasons. First, it is a planetary emergency: "At stake is the survival of our civilization and the habitability of the Earth." Yet this turns out to be far from the truth. As we saw above, this is not what the science is telling us for the temperature rise over the coming century. If anything, the science tells us that *fewer* people will die with moderately more heat. Of course, Gore has several other arguments, which we will also address below.

Gore's second reason is probably more telling and closer

to the truth. He tells us how global warming can give *meaning* to our lives.

> The climate crisis also offers us the chance to experience what very few generations in history have had the privilege of knowing: *a generational mission;* the exhilaration of a compelling *moral purpose;* a shared and unifying *cause;* the thrill of being forced by circumstances to put aside the pettiness and conflict that so often stifle the restless human need for transcendence; *the opportunity to rise.* . . . When we rise, we will experience an epiphany as we discover that this crisis is not really about politics at all. It is a moral and spiritual challenge.

He explains how global warming can give us a moral imperative, like the one Lincoln had for fighting slavery or Roosevelt had against fascism or Johnson had for the rights of minorities.

It seems unrealistic to expect that climate change will give us such singularity of purpose. If anything, the ten-year drawn-out battles around the relatively minor restrictions of Kyoto show us that anything costing individual nations trillions of dollars will be strongly contested and lead to strife rather than serenity.

But perhaps more important, should we go for the exhilaration of a generational mission just because it makes us *feel* good? Should it not actually be because we are *doing* the best our generation can do? And this, of course, brings us right back to asking whether there are greater opportunities for us to engage first.

To be fair, Gore does point out that there are many other generational missions:

> The understanding we will gain [from tackling climate change] will give us the moral capacity to take on other related challenges that are also desperately in need of being redefined as moral imperatives with practical solutions: HIV/AIDS and other pandemics that are ravaging so many; global poverty; the ongoing redistribution of wealth globally from the poor to the wealthy; the ongoing genocide in Darfur; the ongoing famine in Niger and elsewhere; chronic civil wars; the destruction of ocean fisheries; families that don't function; communities that don't commune; the erosion of democracy in America; and the refeudalization of the public forum.

But as the list goes on, it becomes clear that it is in need of realistic prioritization. Gore essentially tells us we should fix all things from climate change to democracy. And it would be beautiful if we could do so. But so far, we haven't addressed any of these very well. Perhaps it would be wise to start thinking about which we should do first.

Gore tells us that we need to hear the voices of the future speaking to us now. We have to imagine them asking: What were you thinking? Didn't you care about our future? He is absolutely right.

Do we want future generations to say that we have spent trillions of dollars and perhaps done a little good for rich people in a hundred years? Or do we want future generations to thank us for giving billions of poor people a new

beginning and a better life, which will enable them to better deal with whatever challenges the future holds?

In other words, do we just want to *feel* good, or do we actually want to *do* good?

Smarter Strategies

This does not mean we should do nothing at all about climate change. It does mean we need to be much smarter about what we do. In place of expensive and inefficient strategies like Kyoto, we should search for new solutions, which I will discuss below.

We should start thinking about how we can cheaply tackle climate change in the long run. The big problem with cutting carbon emissions Kyoto-style is that it costs a lot now and does very little, far into the future. And as long as cutting carbon has such high costs, countries such as China and India will never participate.

Rather we should focus on cutting the cost of reducing CO_2 emissions. While this may not be as romantic as a "global mission," it is much more efficient, stands a much better chance of working, and will really help humanity.

3

Global Warming: Our Many Worries

In chapter 2, we looked at what happens just when temperatures increase and saw that it was no catastrophe. But of course, there are many other concerns about global warming, each often presented as a disaster-in-waiting, urging us to drop everything else and focus on cutting CO_2. As it turns out, these statements are often grossly exaggerated and divert us from making sound policy judgments. Let's take a realistic look at some of them.

Melting Glaciers

Over the past millennium, temperatures have gone up and down and up again from natural causes. (In the past 150 years, temperatures have diverged even more upward due to global warming.) Between about 900 and 1200 there was a relatively warmer period known as the Medieval Warm Period. The warmer climates and reduced sea ice made possible the colonization of the otherwise inhospitable Greenland and Vinland (Newfoundland) by the Vikings. In