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20 April, 2009

Announced title: Climate: The Next Generation
Updated title: Green Business: A Key to Protecting Climate

Scientists are conservative people, and if asked about the future of climate change, their first answer is apt to be, well, it is very uncertain. If pressed they will say climate change is already happening and its impacts are intensifying. If pressed further about the extent of future climate change they will tend to give a range of estimates, rather than a single number. We say, for example, that the best estimate for increasing temperature up to the end of the century is between 1.5 and 4 degrees Celsius (relative to the 1980s and 90s), and that annual greenhouse gas emissions in 20 years will be between 50 and 80 gigatons (CO_2-equivalents per year). Even though our ranges reflect our best assessments of future uncertainty, we still have to spend a lot of time defending the upper part of the range because many think they are exaggerations– "How sound is the science behind these high estimates?" "Are the assumptions for your high estimates really likely?", and so on.

But I have noticed over the past several months that the situation is changing. More and more evidence indicates that perhaps it was our *low* estimates that are questionable, and that the tempo and impacts of climate change are, and will be, faster and more severe than we earlier expected. In short, our upper estimates, do not look so unlikely anymore.

One example are the set of scenarios of future greenhouse gas emissions that I published with IPCC colleagues nine years ago. A recent paper in the Proceedings of the National Academy of Sciences of the USA showed that current emission trends are outside the *highest* of our scenarios.

More evidence for a faster tempo of climate change is coming from the very ends of the earth. Up to now, the Antarctic was thought to be the only major land surface of the earth that was not warming (except for the Antarctic Peninsula). Now colleagues at the University of Washington in the U.S. are reporting that temperatures are indeed increasing also in the West Antarctic. This, of course, has implications on the risk of melting of the Antarctic ice cap and eventually the impact of this meltwater on sea level. We have to keep in mind that the melting of the West Antarctic Ice Shield alone will boost sea level by 5 meters, not taking into account the other factors (warmer ocean temperatures, melting glaciers) already raising sea level.

New studies are also finding a faster-than-expected tempo of change on the other side of the earth. It has been assumed for some time that warming would eventually cause the Arctic Ocean to be ice-free in the summer, but "best estimates" were that this would happen at the earliest in 50 to 70 years. But some Arctic climatologists are now saying that this could happen by 2015; good news for those wanting to take a pleasure cruise to the North Pole, but less so for those of us concerned about the heat balance of the earth. Once the Arctic Ocean loses its summer cover of ice, solar radiation will no longer be reflected off the ice and instead will be largely absorbed by the ocean, accelerating the heating of the Arctic. New studies from the National Center for Atmospheric Research in the U.S. indicate that this heating effect could extend up to 1500 km inland into Siberia, Canada and Alaska. Faster warming on these Arctic land masses will put permafrost at greater risk of thawing rapidly and this, in turn, increases the risk that methane and

other carbon compounds, locked up for ages in the permafrost, will be released to the atmosphere, further accelerating global warming.

This risky chain of events illustrates a growing opinion in the scientific community that we are pushing up against thresholds in the climate system harder than ever before. We call these thresholds "tipping points" because warming beyond these points tip the balance of the earth system into relatively fast and rather unpredictable changes. One of these tipping points could be a massive dieback of our great northern forests that provide much of the world`s wood, as well as livelihoods to countless people in the North. Another could be the disruption of the monsoon in India which provides moisture for the food production that feeds hundreds of millions of people.

It should be clear that these events are not inevitable, but that the faster and more intense the climate change, the greater their risk of happening. In fact "risk" is a common theme when we speak about climate change, just as it is for investments for business people. Climate scientists and business people have this in common – we both recognize risks … and are interested in minimizing them. How do we reduce the risks to the climate system? Reducing emissions is the surest way to do so. The lower the emissions, the lower the concentration of greenhouse gases in the atmosphere, the lower the tempo of climate change. The lower the tempo, the better we can adapt to the climate change we cannot avoid, and the better we can reduce the risks of exceeding thresholds which *we have to avoid.*

How much do we have to reduce emissions? Many scientists, myself included, believe that a sensible goal would be to hold the increase in global temperature to two degrees (relative to when greenhouse gases began to accumulate in the 19th century). This in fact has been EU policy for some time. How much emissions would be allowed under this limit? As good scientists, the first answer is, of course, that`s very uncertain. But if pressed, a best estimate would be that global emissions need to be reduced up to 2050 *by at least 50%* relative to 2000. The problem is that if we don`t act, not only will emissions continue to rise as they now are doing, but they are very unlikely to even level off within the next few decades and may actually grow 50% larger by 2030 (relative to 2000).

What emissions do we need to reduce and where do they come from? The world energy system, from refineries to power plants, accounts for about 1.25 out of every 5 tons of global greenhouse gas emissions; industry accounts for 1 out of 5 tons, and buildings and transport combined account for another 1 out of 5 tons. Summed together these sectors account for two-thirds of all greenhouse gas emissions, and these are exactly the sectors where green business can do so much to reduce emissions through renewable energy, low-carbon industries, energy-efficient buildings and very low-carbon vehicles.

There is a specific and real connection between the idea of green business and lowering the risk of climate change. Every ton of greenhouse gas reduced by green business will slow the tempo of climate change and lower the risk that we exceed the apparent thresholds in the global climate system.

Green business is more than providing jobs, or protecting local air and water quality.
Green business is an insurance policy against the very real and growing risk to our global climate.

Bio Sketch
Prof. Joseph Alcamo

Prof. Joseph Alcamo is Chief Scientist (Designate) of the United Nations Environment Programme. He is currently Director of the Center for Environmental Systems Research at the University of Kassel, Germany and Professor of Environmental Systems Science and Engineering. Alcamo has worked for 14 years with the Intergovernmental Panel on Climate Change and has been a lead author of many of its reports, including the most recent report on the impacts of climate change. He is well known for contributions to global modelling of the environment and development of global scenarios. Alcamo was winner of the international *Max Planck Research Prize* for achievements in global change research. He is an American citizen.