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"Globalization in the Era of Environmental Crisis"

UNITED NATIONS
UNCTAD

Mr. Secretary-General, Mr. President of the Council [sic, should be Board] and esteemed members of the podium, distinguished delegates, and ladies and gentlemen, let me say what an incredible honour and pleasure it is to be here today. I'm most grateful for the invitation and for the chance to think together with you at certainly one of the most complicated times of modern economic history. We face more challenges per minute than we could handle per month, per year, per decade. They're cascading upon us, these crises sometimes seem to be independent whether it's finance or energy or climate shocks or food, but they are interconnected. They are all signs of a tightly-knit world that is still unable to come to grips with the real nature, challenges, opportunities and threats of globalization. and UNCTAD plays a remarkable role in helping to sort through this challenge and give guidance and wisdom to policymakers around the world and to speak on behalf of those whose voices often are not heard adequately in the international policy debates and so I'm most grateful not only to be part of this distinguished lecture series inaugurated 27 years ago by Dr. Prebisch himself, but also to be here to help celebrate the 45th anniversary of UNCTAD, which is a great accomplishment and a great occasion.

I'm going to talk about the global economy in the context of the environmental challenges that we face and, in some ways, just as we would think by reading

Dr. Prebisch's lecture from 1982, or many of the intervening lectures, you will say, well, we know those things, and, indeed, perhaps our biggest challenge is not exactly what we know, but how we act. How it is that we lose so much time on a planet that does not have the time and the luxury that we think it has.

1982 was an era of financial crisis for the world: the entry of the world into a developing country debt crisis. It was already an era where the challenges of the environment had been noted/recognized in the Stockholm Conference in 1972, and it was just a few years later where Dr. Gro Harlem Brundtland chaired the famous commission that put sustainable development on the agenda, but we've lost time since then. In fact, 1982 really marked the onset of a new era of neglect in international political economy. I think we will look back on the Thatcher-Reagan era as a period of disaster, actually, where we entered into decades of inaction, of a misunderstanding of how the public sector, the private sector and civil society need to work together to solve our problems. I know in the United States, and I'll talk about it that this have been an era since the early 1980s of degradation of our institutions and a worsening of the texture of our society – with more poverty, more people falling through a tattered safety net, and it's not just that we have lost time on the environmental issues, we've spent 27 years since Dr. Prebisch's inaugural lecture

filling up the atmosphere with greenhouse gases and bringing us ever closer to the thresholds that can lead to devastation for large parts of the world.

UNCTAD in its *Trade and Development Report 2009* takes up climate change and some people may wonder, is that really UNCTAD'S role? And my answer to you would be emphatically, yes. I'm very excited that UNCTAD has taken up the theme of climate change in this year's *Trade and Development Report* because we can longer put economy and ecology in separate categories. They never were in separate categories: our economy rests on the base of ecology because we are biological organisms. And we depend on water, the food we grow, the safety from natural hazards, the coming of the rains on time; and millions die and hundreds of millions are threatened by inadequate food supply, by chronic drought, by disasters that befall them, ever stronger storm events, higher variability, many threats to food security. So there is no separation of development and environment. This is not a question of which unit in the U.N. should take up a challenge of climate change – all units must – because the environmental challenge, the economic challenge and the social challenge are so integrally connected that they must not be separated intellectually or in policy terms or in the negotiations and brainstorming as a world that we undertake.

And that is my central message: we face a dire and growing crisis. We are in the age where sustainable development is truly the fundamental challenge. And I tell my students and young people and my children that theirs will be the generation where sustainable development is not a back page issue. It will be the front and centre challenge of their generation, even if we, the older folks, have left them with a world that is unstable and that is unprepared for these challenges. They're going to have to solve them and we leave them and are leaving them a world of peril and we have to better than what we're doing right now.

Our world is literally unsustainable right now the way it operates. And I mean that in all scales and dimensions. Our incipient macroeconomic recovery from the crisis of last year – the crash of 2008 – is very fragile and it is unsustainable unless we have what we promised we would have but do not yet have and that is a green recovery, meaning that we recover in a way which directs our efforts, our resources, our investments towards sustainability. We will not even be able to manage a short-term macroeconomic recovery unless we integrate strategies for climate change mitigation and adaptation right into our macroeconomic policies. I'll explain why that is in just a few minutes.

We are unsustainable socially. The world fabric is coming apart, not coming together. The gaps of the richest and the poorest are widening. There are, of course, poor countries getting richer – there is no iron-clad law that says the rich get richer and the poor get poorer – that's not correct, but it is also true that many of the poorest people on this planet are dying of their poverty, and, if not dying, struggling to survive and falling further and further behind.

My team is working in many of the dryland regions of the world: places that I regard as the most fragile of the whole planet, where the rains are unpredictable and where this year there are drought conditions in many places and people are dying and their animals are dying and it's not just their soils that are drying up, but so too their hopes and their future and their livestock are dying along the way and the world is not ready and it is not organized for a proper response, so, socially, we are on an unsustainable course right now.

I see it even within my own society in the United States. It is true that the middle-class is coming apart and people are falling more into poverty and vulnerability. The social safety net in the United States became tattered in the last 30 years. Shockingly so. Our students don't finish high school; they don't finish university. Even though we're a rich country that many people think of as the world's

leading country, or world's leading economy, but I can tell you the social conditions are bad and the threats are high.

And we are unsustainable, of course, in ecological terms, as well. This is on a time-scale that goes beyond a year or two, though some people are paying the price right now. A herdsman in northeast Kenya pays the price right now. A farmer experiencing water stress in India pays the price right now. But we are on a path in which tens, then hundreds of millions and even, according to some possibilities, billions of people, will be put at risk by the ecological trajectory that is the logical counterpart of the way that our economies function right now and that is unacceptable for all of us and any of us with children and any of us that knows children, that means all of us knows that we have a responsibility which is first and foremost to look after their needs and the world that they're going to grow up in and we're not doing our job.

What's happening? What's happening, of course, on the ecological front is that the world is really bursting at the seams. Now some part of that is due to success of our economic prowess. We have become so productive that we can mine the oceans of fish till they disappear, we can mine the lands of mineral resources until they're gone, we can deplete resources at an ability that's absolutely staggering, because

we've become pretty good at it through almost magical technologies. We've also become very numerous, of course, and the population growth rate continues at an unsustainable course – even though the rate has come down, we are still increasing the human population 75-80 million people per year. And that means in a little more than a decade, another billion people, and we're on a trajectory of adding more than 2 billion people by mid-century to a planet that is already profoundly stressed and where each of those persons on the planet expects to have their human rights and they have their expectations and we have an extreme collision of resource and possibilities, and it's getting tougher.

We can pay homage and we should pay homage, I suppose, at this moment to Norman Borlaug, who passed away a couple of days ago. Really, a great man and a great humanitarian. The winner of the 1970 Nobel Peace Prize for his contributions to plant breeding, which enabled the green revolution. And through technology, indeed, Norman Borlaug and his colleagues in India, M.S. Swaminathan, Agriculture Minister in the 1960s, Subramaniam, and leaders around the world were able, by and large, although not everywhere, to keep food supplies ahead of human population.

And that was a wonderful achievement, an historic achievement and also evidence of what we can accomplish when we put our minds to it, but let's be clear, it

didn’t solve the problem of population and it didn't prove that our planet is inexhaustible because even in those places where the green revolution occurred, India has now doubled its population since the 1960s; per capita grain production is falling in many places in India and the water pumped out of the ground water aquifers to enable the green revolution is depleting those aquifers now and putting at risk vast populations – so everything has its side effects. And the fertilizer that is the counterpart of the high-yield seed varieties and the water is polluting the estuaries around the world, so it is a mistake to think that since we were able to improve technologies and keep ahead of populations, that somehow we have solved the population problem. The solutions are only imperfect. They have many side effects. The stresses on the planet are absolutely growing, and if we don’t stabilize through voluntary means, the human population, especially in the places where it’s growing fastest, which are the poorest places in the world, we can never win the challenge of ecological sustainability or social and economic sustainability, because we cannot keep ahead of an ever-growing human population.

Now the concept that I really believe is pertinent for all of us, and that I want to spend a few minutes on, is a concept that was coined by another Nobel laureate, the atmospheric chemist, Paul Crutzen, who is one of the three atmospheric scientists who discovered the ozone depletion effect of the chloro-fluorocarbon. A great

discovery that saved vast numbers of people and that spared us vast destruction. And, incidentally, I should add, because I'll get to his concept in a moment. We didn't even know about ozone depletion effect except by the accident of the brilliance of these scientists and then the accident that we actually had a NASA satellite that could take pictures of the hole of the ozone layer above Antarctica and I mention that fact because I tell you, ladies and gentlemen, we do not even know what we're doing to the planet. Our effects are so pervasive, so inclusive, we are doing damage we do not even know now until the next Nobel winning scientist explains to us how we are destroying the life support systems of the planet through some mechanism that we're not even aware of today. That's what Crutzen and his colleagues did.

So a few years ago, Paul Crutzen coined the neologism, the Anthropocene, as the term for our new age. So what is the Anthropocene? That's a geologic term meaning our new geologic epoch. If you ask a geologist right now – other than one steeped in Crutzian terminology – what epoch we are in, they'll say the Holocene. That's the era that followed the Pleistocene, the ice-age era. Now we're in the Holocene, the post ice-age, post-glaciation. And that's been for about 11,000 years. But Crutzen says no; we've passed the Holocene; we're now in the Anthropocene.

What is that? Of course, anthropo is from the Greek and means human, and cene means epoch, so he says we're in the human-made epoch of the planet. What does he mean by that? He means that we're in the age of the planet – the geologic age mind you – where the human activity dominates the earth processes. This is an extraordinary concept: that humanity has become so large in absolute number and in average economic activity per each of us, that we have overtaken the physical earth processes in vital ways to the point of threatening the stratospheric ozone level, to the point of changing the climate, to the point of fundamentally changing the hydrologic cycle and so forth.

Now you could regard that as a metaphor, the Anthropocene, that that's a metaphor, almost a poetic expression to say that humans are having a lot of influence on the earth physical processes, but, interestingly, the American Geologic Society took seriously this idea and tested it by the standards of geology whether we have indeed entered a new geologic era. There are many standards used to analyse paleo-climates or paleo-geology to say when did an old era stop, when did a new one begin. For instance, sediment patterns on the planet or climate patterns and so on and they came to the conclusion that Crutzen was not just speaking in metaphors, but speaking in rigorous, geologic terminology: we've entered a new era where Earth processes have fundamentally changed.

Now in what ways have they changed?: in several ways of crucial note for us. First, 7 billion of us now, and remember that is 10 times the number that lived when Malthus wrote "The Principles of Population" in 1798, 10 times more. 7 billion of us – it's actually 6.8 billion, but I'm rounding – 7 billion of us are demanding so much food, so much land use, that human beings are now appropriating almost half of the photosynthesis on the planet for the primary productivity as it's called. We're doing that in our croplands; we're doing that in our pasturelands. And these calculations are also including the photosynthesis lost because they're under the asphalt of our cities. In other words, places where there was photosynthesis, but because of human habitat, there is no longer photosynthesis. Now that's extraordinary – we're taking about half, maybe 40-50% – of the primary food production on the planet for one species. You can be sure what that means. That means the mass death of other species, because we are appropriating what used to go for the rest of the biosphere. It's extraordinary. That may seem like a zero-sum struggle, but it's a negative-sum struggle because we are now pushing so hard on the food supply that we are leading to extinction or disappearance or dramatic population drop the very plants and animals that we depend on for our survival. The pollinators: disappearing; whole classes of amphibians: disappearing; fisheries around the world: disappearing. Absolutely extraordinary. Habitat destruction, appropriation of food supplies, direct effect.

We're also fundamentally interfering in the hydrologic cycle: the water cycle, because we've put on about 60,000 major dams on the rivers around the world. Also, I say these numbers – I can't even imagine these numbers – how could there be 60,000 dams? But that's the count, so I'm just telling you what I read, because I can't really, viscerally, accept that. But what I do know is that many of our major rivers no longer flow to the sea. And you know it too. Major river ways drying up well before they reach the sea: the Ganges, the Yellow River, the Rio Grande is the Rio Pecaño. This is the effect of mass interference of human beings in the hydrologic cycle and there is a lot to come, ladies and gentlemen, because a very significant part of our food supply comes from irritated crops. A very significant proportion of our irrigated crops come from groundwater irrigation. A very significant part of the groundwater irrigation is being discharged much faster than it's being recharged, so that the water table is falling sharply, and we have large populations at threat of water depletion. And when this is happening on the North China Plain or the Indo-Gangetic Plain, or the Ogallala Reservoir in the American Midwest, or in the Andes, there are no easy answers right now. There are short-term answers which are lousy.

We were just lectured to in the United States in an editorial by the Wall Street Journal, our dumbest paper with the largest business circulation, but so irresponsible

editorial policy. I put it right at the worst of the world because of its irresponsibility. We were just lectured "keep pumping out of the draining wetlands and the lost reservoirs in California for the irrigated fruit crops and so forth, why save this fish or that fish," told the Wall Street Journal. They know nothing about ecology. Their calculations are about profits a month at a time. It's ignorance, but it's showing what we are really doing right now. How we're coming to the edge.

Same thing with our glaciers. The glaciers, you know, are pulling back. Snow melt, which is a buffer for seasonable river flow in the spring and summer, which provides the summertime irrigation for our food system, is coming earlier and earlier, so some snow melt never turns to snow anymore because of the warming and that means you get winter run-off of the water, rather than spring and summer run-off, and that means the water's going before the crops can begin to develop. And the glaciers, of course, are going to disappear entirely in many or most places, and that is water supply for hundreds of millions of people in the Andes, in the American Northwest, on the Himalayan Tibetan Plateau.

What are we doing about it? Nothing right now. We're barely thinking about these things in a serious way. Because human populations are pushing against new kinds of animal reservoirs, because of the way we grow our food industrially, raise

our beef and chickens and pigs, and so forth, we're getting emerging and re-emerging infections. Swine flu is a triple combination which probably results from the complexity of how our pig supply and human populations and avian populations are interacting to produce a triple combination of H1N1. We're hoping, it looks like it's relatively non-lethal, although it's absolutely epidemic. But it shows the kind of emergence that will happen globally, repeatedly in the future. We've seen it with SARS; we've seen it with H1N1; we've seen it with avian flu and, of course, we've seen it with AIDS, because HIV was also the result of human penetration into the rainforest environment where simian immunodeficiency virus, SIV, was passed among the chimpanzee population. And probably 70-75 years ago there was a zoonotic transmission from chimpanzee to human populations and that unleashed a global pandemic. That's not an accident: that's also human beings pushing into new areas because of our spilling over into unusual habitats.

And I've not even come to the one that is the biggest of all: and that, of course, is climate change and the greenhouse gases. Everything I've said – even besides that – we would have problems enough, not everything, because the glacier and snow melts relates to that. But the water crisis and the dams and the zoonotic diseases and so forth have their own dynamics, as does the food supply and the land clearing, but add on top of that the climate change that's underway, and not just the climate change,

but the other effects of the greenhouse gases. We've overtaken two critical chemical cycles: one is the nitrogen cycle, because humans are now putting on the land more nitrogen than is fixed by normal, chemical, biological, physical processes. Nitrogen that is otherwise fixed by the bacteria, fixed by the lightening, we now are putting on more through nitrogen-based fertilizers to feed the population. That's having multiple effects. It's contributing to the nitrous oxide which is one of the greenhouse gases of significance. It's also contributing to the hypoxia – the dead zone – of 130 estuaries around the world, poisoning one of the key eco-systems of the planet, where the river water and the ocean water meet and produce an area of remarkable biodiversity and critical supply of food for humanity and these areas are being killed through the run-off of phosphorus and nitrogen from the fertilizers.

Turning to the carbon cycle – the other chemical cycle we are so badly deranging – we've raised by one third the carbon concentration in the atmosphere from about 280 parts per million of CO_2 in the pre-industrial era, to about 389 parts per million now. And carbon dioxide, of course, is our main greenhouse gas. It's our main climate changer, but it's not only changing the climate, as you know, it's acidifying the oceans. Even if carbon dioxide were not changing the climate of the planet, it would be devastating the ecosystems in marine areas because the Ph of the oceans is falling because of the dissolving of CO_2 into the oceans, carbonic acid,

reducing the Ph and that is putting a threat all manner of shellfish and ecosystems, coral, plankton and other species that have exo-skeletons that depend on a proper balance of carbonate ions in the oceans.

But the climate effects are the biggest of all. Because as everybody knows by now, though almost nobody acts upon by now, we are on a trajectory that is absolutely, profoundly unsustainable and frightfully dangerous. Now one thing I want to say about the rise in carbon dioxide. Psychologically, we are unequipped to understand it, at least I am. Because it is a stock effect. It's the accumulation. It's not a flow. Sometime we'll arrive at a moment where the scientists will tell us, "Oh, by the way, this area is no longer habitable. This one is going to have devastating hurricanes, with frequency. This one is going to be subject to intense flooding". Then we're going to say, "Oh, sorry, sorry, now we get it. We'll cut down." And what I want everyone to understand is you can't anymore cut down after that to un-do those problems. You've already reached the threshold. This is not like a flow effect where you say, "Oh, my God, I didn't realize … yes, you're right, it's so bad, we're going to stop right now." Too late. When you don't like your climate anymore, it's too late. When your beautiful homeland is not inhabitable anymore, it's too late. Because the carbon dioxide is going to remain centuries in the air and because anything you see now… you don't like the storms, you don't like the droughts, you don't like the

variability, you don't like the disappearance of the short rains as is happening over the Sahel ... you don't like that? There's a lot more to come even if we were to stop at zero, new emissions. This is interesting too. We're only observing about half the effect of what we've already caused, maybe even less. Why? Two reasons: one is that part of the warming is being masked by the pollutants. When we put the white aerosols, the sulphates, into the atmosphere, that reflects some of the incoming solar radiation so it's a partial offset to the warming. But those sulphates will get washed out by the rain in a few weeks as soon as we have smokestack scrubbers and all the rest. So as we clean up the air, we will unmask climate change which is being masked by pollutants right now. That's one reason why we are masking what we've done. That will happen.

The second reason is that the oceans take longer to warm than the land, so we have a phenomenon called thermal inertia, which means that it will take decades for the full effect of the greenhouse layer to warm the planet because the water warms less rapidly than the land and it keeps the land relatively cooler than it will be in full equilibrium. And when you add those two effects together, maybe what we've done till this moment which is measured at something like .7 or .8 of one degree centigrade warming on average on the planet, maybe the effects of what we've already done are 2 degrees centigrade, maybe even more, in their full, short-run, decade-scale effect.

Then comes the scientists, including my colleague, James Hanson, the American Government's leading climate scientist, the one that George Bush tried to silence, but the truth will not be silenced, especially not by some idiotic 24-year-old without a college degree in the White House trying to stifle the speech of one of the leading scientists in the world. That's how the American government was working under the Bush Administration. But my colleague is brave and he wouldn't let himself be silenced and he wouldn't let – as I said – some completely irresponsible no-nothing do it. And I'm not only talking about the President, I'm talking about the 24-year-old, also.

What he says is that if you look at the planetary history, what you see is that the warming that we get is only the start of a long cycle of feedbacks. Why? Because if we warm the planet and we melt the ice cover, we change the reflectants of the planet, what's called the "albedo". And so sunlight, solar radiation, that was being reflected back into space rather than warming the earth, now gets absorbed in the earth and raises the temperature of the planet. So once we have the albedo effects set in, and perhaps other effects, like methane release in the permafrost or even CO_2 release from the oceans and so forth or a drop of absorption of CO_2 from the oceans, the long-term effects of what we're doing could be much larger than the short-term

effects. So what Hansen says is we've already passed what in legalese is called the dangerous, anthropogenic limit. Or the limit of anthropogenic interference in the climate system. He says that's 350 parts per million and we're nearly at 390 parts per million.

But the effects of climate change will be pervasive, they already are. It will mean more droughts, more floods. It will mean loss of irrigation water when we need it, higher rates of evapo-transporation, more intense episodes of precipitation leading to more run-off, rather than more percolation into the soils. Higher temperatures will mean loss of crop yields because there is temperature stress to the crops. It will mean more extreme storms: the typhoons in the Indian Ocean and in the China Sea and in the Caribbean. We could easily, in our part of the world, see more see category-4 and category-5 hurricanes and once you say, "Oh yes, yes, that theory was right." It's too late, because that will mean that the Caribbean or Biloxi, Mississippi, or New Orleans, or Houston, or New York City, are subject to more and more relentless hurricanes of higher intensity and we don't know how to turn that off, that's for sure, once it's turned on. Not to mention the rise of sea levels where the breaking up of the West Arctic ice sheet in Greenland is proceeding at a rate that we do not understand, but could be highly non-linear by the ice sheets cracking up rather than simply

melting – nobody knows for sure. So all of this is to say the age of the Anthropocene is real and is upon us.

Now if that were not enough, ladies and gentlemen, I'm going to add on another layer. That would be true even if we stopped what were doing right now, even if there was no more economic growth. But, of course, it is one of the key objectives of the world, to continue economic growth. And not only perfectly understandable, I work round the clock trying to promote economic growth in poor countries. That's a very worthy thing to do; extremely important. Especially important for the poor populations of the world. There is absolutely no shred of legitimacy to saying, "Sorry, stop, we've filled up. No more." So there's a lot more growth coming. And one of the pieces of good news is that many parts of the world have unlocked the mobilization of science and technology for rapid growth.

China's economic growth is the fastest in history. We should all admire these phenomenal successes: 10% per year for 30 years. That means a doubling every seven years of the size of the economy. Absolutely phenomenal. It's led to a dramatic drop of poverty. It's the kind of development we want to see happen. But think of the challenge of sustainability in a context not only in a world already unsustainable, but where growth is going to continue in the developing countries and it will continue

because the essence of growth is mobilizing science and technology to meet human wants and needs, and that is now the providence of much of the world. Not all of it: not the ones absolutely stuck in a poverty trap, but much of the world. And that means we can except more growth ahead – just what we want.

So let me just give a scaling, a sense of this: the rich countries average about $40,000 per capita, PPP, purchasing power parity adjusted. The world as a whole averages about $10,000 PPP, per capita, that is. So in purchasing power adjusted terms, the rich world is about four times the average, and the developing world is about $4,000 per capita in purchasing power adjusted terms, one tenth of the rich world. Suppose that the rich world stayed where it is right now and the developing world caught up. What would that mean for total output in the world? Well, that would be a factor of 4 increase of production for today's population – a factor of 4 – because we go from an average of 10, to an average of 40,000. But we're not done yet, because the population is growing. The current trajectory of the population will take us to about 9.2 billion people by 2050, another 40% or so. Take an increase of 40% and a four-fold increase of output per capita: it says that even if the rich world grows no more, the total size of the world economy would be a six-time increase, roughly. Think about it, ladies and gentlemen, the paradox of our time. We are trying to promote economic development: I'm doing it every morning, noon and night, I can

tell you – and I lose sleep over it too, and that means we're aiming for six times the production of today in a world already ecologically unsustainable. How are we going to do this? Now that's a good question. And that's what I want to talk about today. So that was all a prelude. But I'm not going to keep you for six hours. I'm going to speed up a little bit. That was the backdrop of my words.

How can we be unsustainable today, pushing for a massive increase of output which we do and want, and which is going to occur by the way whether we want it or not because countries will achieve economic growth. How can we possibly achieve sustainability in this way? Well, I think the answer can only come in a couple of ways and only one of them, in my view, can be the dominant way. Of course, one way is that we hit disaster one way or another, so that the growth doesn't occur. Maybe the rich world collapses, or the poor world stops growing, or we have global crises, but one way or another, the world's aspirations for major regions are not fulfilled. I don't want my children to be in that world, by the way, because that will be a very dangerous world. Aside for what it will mean for the people involved, that will be a world of conflicts. I've not yet seen a president or prime minister in the rich world say, "I've ran the numbers and I'm campaigning on cutting our living standards by half." Don't count on it, ladies and gentlemen. This will not go smoothly. You may say, "Over-consumption – it's time to conserve." Don't count on it happening

smoothly. That has not been the rallying cry in the United States, or even in the more enlightened European Union on these matters. Everybody wants to grow more. In fact, nobody is campaigning on a pledge, "Let's stay where we are," even – which was the basis of my calculation.

The other way is from the famous, so-called, IPAT equation. I equals P times A times T. I means impact of humans on the environment; P is population; A is the level of economic activity; and T is a measure of technology. And the famous equation said that our human impact is equal to our population, times the output per capita, times a measure of our technological burden on the physical environment. And if you take that view and you say, yes, we want A to go up – that is the per person level of economic activity. The only ways to do that with a lower impact are either to slow the population growth rate, and maybe gradually have it come down, but not in a disastrous way, because that would also violate what we're trying to accomplish; or a change, fundamentally, of our technological systems. So I would recommend two things: I'm going to only mention one quickly, and then I'm going to come to the second one.

One thing I would recommend is that we re-double our efforts to stabilize the human population. I believe every country should take the responsibility, where

populations are growing quickly, to bring them under control through voluntary reductions of fertility. Africa cannot go on with total fertility rates of five children, or six children, or seven children, per woman in the countryside which is the levels that now persists in much of rural Africa. These places are bursting at the seams. And you know that the U.N. forecast for sub-Saharan's population is that it will grow from 800 million now, to 1.8 billion by 2050, in a place already under profound ecological stress and extreme poverty. I believe that, if it occurs, it cannot be consistent with the kind of economic development we long for in Africa. I believe that African's economic development requires leadership to reduce the fertility rates voluntarily and significantly and rapidly.

How can that be done? There are basically three aspects to that, very briefly. One is make sure that all children survive, because when parents see that their children are surviving, they're ready to have fewer children. They don't have to have so many children as an insurance policy against child mortality. When they know that their children will survive, they'll cut the family size voluntarily. Second, make sure family planning and contraception is available to all for free. Poor people cannot afford contraceptives and family planning. You charge for it, it will not reach the poor, who are the one's having the most having children. And third, empower girls and women to make their choices. And the single most important thing of all is

enable young girls to stay in school – not get married at age 12 – but to finish primary school, and then secondary school.

We're working in a village in Ethiopia, for example, where because of fellowships that this U.N. project is bringing, girls are graduating high school for the first time. I can tell you this is a traditional, patriarchal community. The men, the fathers, could not be more proud. They're thrilled. They're not keeping their daughters out of school. They're so happy that they have an opportunity now for a future. There is no cultural obstacle, in my view. There's a resource obstacle. The Millennium Development Goals, which I work on, got it wrong when it said universal primary education. We need universal secondary education. This is absolutely a prerequisite for a normal and productive life in the 21st century. This would bring the fertility rates down from 6 to 3 or under very quickly – this set of measures. Populations could begin to stabilize and this would be an enormous benefit for the whole world, especially for poor families, poor communities, poor countries, poor regions.

But now let me turn to the T, which is an even bigger and more complex challenge: the technology. It must be the fundamental role and goal of all our policies going forward to have a fundamental, technological overhaul for global sustainability. Our current technologies – I hope I've convinced you – are

incompatible with our development objectives and our ecological needs. We cannot go on with the internal combustion engine, with the coal-fired power plants, with the way we grow our food and eat our food now. We cannot simply scale this up. The planet will not accept it. We need a fundamental, technological overhaul. That requires a new kind of economy and a new kind of economic policy, because markets go some way towards technological change, but only some way. The essence of large-scale technological change is public-private partnerships. We will need a new kind of economic strategy, within countries and globally, to bring about the scale of technology change that we need in the next two to three decades to put our planet back on to a sustainable course.

What are those technologies needed? Well, broadly speaking, there are six sectors that contribute to the challenges that I mentioned before, of the Anthropocene. If I look at greenhouse gases, for example, six big sectors: one is agriculture. Maybe the biggest contributor to greenhouse gases is agriculture, something like 18% of total emissions. Second is deforestation, also related to agriculture, maybe another 15 to 18%. The power sector: how we produce electricity with fossil fuels. The transport sector. Buildings and industries.

In general, these are all roughly the same order of magnitude. Power, transport, agriculture, deforestation, are bigger – building and industries, slightly smaller – of the total emissions. We need new technologies in all of those sectors.

Let me talk briefly about a couple of them: the power sector, for example. Of course, we need different ways to produce electricity. Three big categories. One is renewables: wind, solar, geothermal. I'm not a big fan of biomass because we don't have the land area for it. Biomass competes too much with biodiversity and with food supplies. But in big categories, I would say wind and solar; geothermal's a niche. Nuclear power is an important area, and dozens of countries will certainly use that as well, and we need to find ways to ensure that it's used safely.

But the other big category is carbon capture and sequestration: the ability to use fossil fuels safely by collecting the carbon dioxide that's released from their combustion and putting it safely in geologic storage. Now, I want to make a point about both, in fact, all three of those possibilities: the renewables, the nuclear and the carbon capture. The point is those are not commercial decisions alone, those are societal decisions. Those are not something markets choose. Those are something where markets and society have to make choices together. We need regulatory systems; we need research and development; we need public awareness and

education. This is not simply markets. We need cooperation to bring about major change.

I'll tell you a worry that I have about that: seven years ago the Bush Administration announced a program to test carbon capture sequestration called FutureGen. About eight years ago now. To build one or more coal-fired power plants to test how it can capture and sequester its carbon dioxide. So eight years later, how many have we built? Well, let me say that in that time frame – eight years – that's exactly the time frame when President John Kennedy committed America in 1961 to put a man on the moon and bring him back safely to earth within the decade. And the U.S. did it. That same time frame, America can no longer, apparently, build one coal-fired power plant to capture its carbon dioxide. We can put a man on the man and bring him back to earth, but we're not able socially, societally, even to build a power plant anymore. That, by the way, technically is called pathetic. And it's frightening. Frightening. But Europe and China and India are not doing much better in this. We're wasting our time. As if we can write papers and give speeches like the one I'm giving. And that that somehow solves the problem. It doesn't. We don't have in the whole world one coal-fired power plant that captures and sequesters its carbon dioxide, even though the engineers and scientists have been telling us for more than a decade, "You've got to try this, if you want to use your coal."

Let me say to all the coal-burning countries in this room: try it. You've got to try it. Urgently. First if you get there first, you can sell the units to others. I expect we'll be using China's CCS technology all over the world soon. Great. Somebody take the lead. We can't go on more years like this not even building one plant. You can't believe the legal battles in the United States over this. The management, the administrative battles. The arguments over a billion dollars, when we've got trillions of dollars and a whole future at risk. It's just shocking that we can't get this done.

By turning to nuclear, which raises its own complex set of issues, the United States hasn't built a nuclear power plant in 30 years. Are we going to do it or not? Does that fit into the carbon mix? Is that part of a low-carbon economy? Who knows? We need leadership and strategy for that. I think the Obama Administration wants it but there's no plan yet. We don't have a plan. We're less than three months away from trying to close a global deal, we don't have a plan from the United States. We don't really have the makings of an agreement right now. Because we think we have time that we don't have.

I was at General Motors a few days ago, visiting with the engineering team making the new plug-in hybrid, Chevy Volt. A wonderful engineering team, ladies

and gentlemen. Fantastic what our cars of the future could be like. The Chevy Volt could get 230 miles per galloon – that's 10 times what we're getting right now. That's possible, within reach, but it requires partnership in the U.S. that doesn't yet exist. Between the auto industries, the power grid, the power generators, the regulators. It requires subsidies for consumers for the uptake of the early stage of this technology. All the things you need to do for societal transformation. We don't have it yet. What we have is a great idea, some prototypes and a bankrupt GM. And no yet strategy country-wide to bring this about.

So this is another example. I could go on and on: I think you're a little afraid that I'm going to. But the fact of the matter is; the point I'm making is; that we have lots of options. They're powerful options. I had an institute filled with hundreds of marvellous engineers and scientists, filled with great ideas – many of them already at trial stage, some at demonstration stage, some commercializable – but we don't have a framework globally of what to do. And none of this, by its nature, can be done by markets alone.

You could put on a price of carbon — which we should – to incentivize non-carbon energy sources. You can tax carbon. By the way, taxing carbon is the right way to go, not cap-and-trade systems, which are highly cumbersome ways for

politicians not to use the word "tax". That's what they are. If I want to scratch this ear, I should use this hand, not this. This is the cap-and-trade system. This is carbon taxes. In other words, do it straightforwardly, simply, transparently. We do this because politicians don't want to say tax, but that's the straightforward way to get the job done.

But I want to point out that's not enough to solve the problems of large-scale technological change. You need research, development, demonstration, regulation, public knowledge, public acceptability, testing, monitoring. It's a system approach. And inherently, the initial investments in any new technology are public goods, not private goods. They don't give a return to those making the investment. No private company can develop these technologies on their own profitably. They need public partners.

And even with a tax, it's not enough because the first movers are going to lose. They won't get property rights, they'll get a lot of learning that will be available for everybody. So my point is: large-scale technological systems change requires some clever policies on research and development, and demonstration, and regulation, and promotion, feed-in tariffs, subsidies for consumers, first-mover advantages, plus a proper pricing of the externality of greenhouse gas emissions. All of those things, and

over time, there are so many wonderful things we can do to change the way we build our homes, the cars we drive, the way we power our cities and our economies that can solve these problems. We can reduce the "T" in the IPAT equation. We can achieve economic growth at a much lower impact on the planet if we think clearly, systematically, in system terms, with a new kind of market and government approach. Public-private partnership targeted to achieve shared global goals. That's what we need to do in the age of sustainable development.

Finally, where are we on this? We are not where we need to be. The way we structure the global negotiations is not right. Climate change is not a poker game where you hold your cards close to the vest and you bargain with others. That's how we're viewing the negotiations leading up to Copenhagen. Don't reveal your hand, don't say your position because it's viewed as a negotiation. If there is a model for it, it is trade negotiations. That's the model people have in their heads. That's the wrong model for this problem.

The climate change problem is not a trade negotiation in any way. The climate change problem is simply the complex, engineering, economic and social problem that humanity has ever had to face together. And so we are well before the stage of negotiating; we should be at the stage of joint problem-solving. All cards should be

on the table. And we should be discussing, "What can we do?" The U.S. should be saying, "Well, here's how fast we think a plug-in hybrid can be introduced. Here's what we think we can do on nuclear power. Here's what we think we can do in tapping solar power from the Mojave." Europe should be saying, "Well, we have the Desertec project to link solar and North Africa with Europe's energy needs. It's $400 billion. We're thinking of making that investment. And if the new technologies for electric vehicles come along, we could do that the following in our time table." And China could say, "We are a coal-burning economy. 80% of our electricity comes from coal. More than 50% of all our primary energy needs come from coal, so we're ready to take the lead in testing carbon capture sequestration and we're going to put four plants around to see about our geologic capacity to capture our CO_2."

Then we'd start getting somewhere, rather than having only diplomats around the table, with all due respect, diplomats. We need engineers around the table; we need scientists around the table; we need hydrologists around the table. I'd even allow one or two economists around the table, to try to ask how much it might cost for different options. But I frankly don't understand doing this, holding up the cards as if this a poker game. It's too complicated. This is a poker game where the people holding the cards don't even understand the rules of the game. How can they? It's like

playing poker, but you don't know which poker game you're playing. It's too complicated for that. We need to put the cards down and have a new kind of process.

I've wanted all this time that the secretariat of the U.N. Framework Convention on Climate Change have a standing, large technical body. Technical. That is spilling out options, doing costing, asking what Tunisia could do, what's the option for this one, is Desertec a good idea, what is plausible for the next five years in such-and-such country. To my mind, by the way, in that context, the issue of whether a national goal is binding or not is one of the least interesting questions. First of all, what's binding if you can't achieve it? So, if we don't know what's achievable, what's all the talk about legally binding? It's silly. We constantly agree to things that aren't achievable and aren't achieved. We should be talking about, not the debate of what's binding and what isn't binding, but what can we do. What can we do now, what can we do in five years, what can we do in ten years, how can we get this moving. Once we analyse those options, then we can talk about how to share the costs too. Because there's no doubt that the rich world must fund a significant part of the incremental costs of this effort. Absolutely no doubt about it.

But we're debating hypotheticals, right now, not practicalities. We're debating concepts that barely have a real-life counterpart right now. Because what are these

plans the way they are right now? They're not based on real, technological possibilities. They're not based on brainstorming, sharing technologies, creating global platforms for electric vehicles or carbon capture sequestration and the like.

So I keep saying, though, not to much effect, we don't need global negotiations right now, as much as we need global brainstorming. And global problem-solving. We need to get the world's minds together to solve these problems. That's a quite different exercise. Later on we'll figure out how to allocate the costs, once we know what we're doing. But we're not even at the point of really knowing what we're doing yet. We could be there, but we're not there.

Finally, let me say that we've got to get there fast, for all the reasons that I mentioned. Our sustainability depends on it. The current recovery, which is so fragile, of the world economy, that you might not even notice it, depends on robust investment in the future. But if you're an American business, you can't invest robustly right now if you don't know what the rules of the game are. What kind of power plant can you build? What's the cost of energy going to be? What should the auto companies do? How should infrastructure be built?

It all depends on our strategy. We need a strategy. We actually need a plan. That's another bad word in the United States. Plan. We need a plan. Not a rigid, central plan, but a plan, an indicative plan. We need a public investment profile and a time table. And without that, we won't get the robust investments that we need to sustain even the macro-economy. We certainly won't be able to solve the problems of the poorest of the poor. We need to decide to help Africa build an energy system from the ground up. Now Africa has more solar power than any other part of the world. It could provide all of the world's electricity needs were the cables long enough from a little square in the Sahara Desert. And we need to help Africa accomplish that because still 90%, or more of the villages in Africa, I would guess, don't even have electricity still. And I'll tell you, there's one rule of development that I can assure you, there is no development without electricity. It's impossible, impossible. As much as we fake it, it can't be done. So we need to get on with that for the social stability.

And finally, we need to get on with it for the ecological stability. And for that, I mean our children’s future, because what we're doing is reckless right now. And I'm reminded in this regard, always when people ask me, "Well, could we ever agree to these things; could we ever really reach a consensus?" I'm always reminded of the words of John F. Kennedy, in what I regard as the greatest speech of an American

president in modern times, which was his speech on peace at American University in June 1963. And he said, “So let us not be blind to our differences, but let us direct attention to our common interests and to the means by which those differences can be resolved. And if we cannot end now our differences, at least we can help make the world safe for diversity. For in the final analysis, our most basic common link is that we all inhabit this small planet. We all breathe the same air. We all cherish our children's future. And we are all mortal.”

Thanks very much.