

How the rich can save the poor and themselves : lessons from the global warming*

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Humanity faces an imposing array of environmental problems on a worldwide scale, including a catastrophic loss of biotic diversity (especially because of deforestation in the moist tropics), depletion of the ozone layer, acid precipitation, toxification of the entire planet, a growing vulnerability to epidemic diseases such as AIDS, and so on (Ehrlich and Ehrlich, 1987). No problem is more daunting, though, than the gradual warming of Earth's surface because of the injection of greenhouse gases into the atmosphere. And none so clearly shows the interrelationships among all major environmental problems or so plainly demands the attention and cooperation of all nations in order to ameliorate its effects. Although this paper focuses mostly on the problem of global warming, a similar paper could be written based on any of the others.

Global warming: who is responsible

The probable consequences of the greenhouse warming are old hat to ecologists (Ehrlich, 1968; Ehrlich et al, 1977; Schneider and Londer, 1984) but a new concern to most decision makers. At first glance, it appears that all the action is in industrial nations. Those nations produce roughly 75 per cent of the carbon dioxide that comes from the burning of fossil fuels (World Resources Insti-

tute, 1988), even though they comprise only about 20 per cent of the world's population. By this measure, the rich now appear to be the main cause of the coming climate change, and the fate of civilization thus could be determined by energy policies in the industrialized world.

There is considerable truth in this view, but it is very incomplete. First of all, there are many other greenhouse gases besides CO₂. Methane may overtake carbon dioxide as the principal contributor to the warming early in the next century, and among the main sources of methane are rice paddies and the guts of cattle, both of which are abundant in developing nations.

Second, the developing world is the locus of cutting and burning of tropical forests, a process that is a major contributor of CO₂ to the atmosphere. Responsibility for that contribution can be partly assigned to the rich, since their demand for hardwoods, paper products, and cheap beef leads to considerable tropical deforestation. But much is also caused by economic and population pressures in tropical nations. These pressures are often exacerbated by arrangements with rich countries that lead to industrialized agriculture and displaced farmers.

Finally, use of fossil fuels in developing countries is not negligible, and it is rising fast. What would be the consequences of substantially increased use

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of fossil fuels, especially coal, in the less-developed nations? When high quality coal is burned, nearly twice as much CO₂ is produced per unit of energy gained as when natural gas is burned; oil falls roughly in the middle. So the consequences depend in part on which of the fuels are used. Unfortunately, coal is both the worst offender and in the greatest supply.

Is it possible to offset increased fuel burning in developing countries by reductions in industrialized ones? Suppose the United States decided to take a dramatic step to reduce its contribution to the CO₂ component of the global warming by terminating all burning of coal (which now supplies about 20 per cent of America's energy consumption) and not burning anything to replace it. Suppose also that, at the same time, China managed to halt its population growth at 1.2 billion and scale back its development plans so that it only doubled its per-capita energy consumption (from about 7 to 14 per cent of that of Americans, or about the level now found in Algeria). In using its ample supplies of high-sulphur coal to achieve that relatively modest goal, China would produce enough CO₂ to overwhelm the reduction in CO₂ releases resulting from America's unprecedented change. Thus, even without considering the *growth* of populations of either rich or poor countries, the huge populations already existing in developing countries can magnify small and very reasonable per-capita increases into gigantic total impacts.

When population growth is considered, the situation looks even bleaker. China's population control programme is slipping, and growth is unlikely to cease before there are 1.3 or 1.5 billion Chinese. India's demographic situation makes its potential contribution to global warming very large. Suppose India succeeded in reducing its fertility rate to replacement level (about half the present number of children per completed family) in the next three to four decades. Suppose at the same time, in the course of development, India just doubled its per capita use of commercial energy (to about that of China today) using coal. The combination of that increase and population growth would also lead to

the injection of enough CO₂ into the atmosphere to swamp the benefits of the United States' abandonment of coal.

This puts the dilemma of the industrialized nations in a quite different light. What seem rather dramatic changes in energy use-patterns by the rich - much more emphasis on efficiency and conservation, much less coal-burning, etc. - are unlikely even to compensate for increased CO₂ injection into the atmosphere by developing countries - let alone lead to a desperately needed *reduction* in the rate at which that greenhouse gas is released worldwide.

The consequences of warming

People of all nations, rich and poor alike, cannot afford to gamble their futures by allowing the global warming to continue at current and projected rates. Some observers naively believe that the warming will improve agriculture in certain regions and make other beneficial changes. This view seems to be rather widespread (though not universal) in the Soviet Union, where a warmer Siberia and ice-free ports are anticipated. These who expect net benefits from the warming, however, almost certainly are sadly misinformed.

Unless our understanding of how climate works is completely wrong, climate change will not involve a gradual shift from one steady state to another. Humanity instead will probably have to deal with a protracted period during which climates will change rapidly in largely unpredictable ways. Earth's surface and atmosphere will gradually become warmer, and many (but not necessarily all) local climates will also get warmer. But there will also be associated changes in precipitation, and severe hurricanes may well become more frequent. The likely changes in precipitation patterns are still uncertain, but computer models indicate that an increased frequency of droughts is likely in mid-latitudes, including central North America, which is humanity's most important granary in terms of export potential.

In addition, of course, low-lying coastal lands will

be gradually flooded, first as a result of thermal expansion of ocean waters and then as ice caps melt and add more water to the oceans. In the next hundred years, a sea-level rise of perhaps 0.5 to 1 meter will greatly increase the chances of storm surges carrying floods far inland in low-lying coastal areas. Such surges could cause millions of deaths in places such as Bangladesh. That same "small" rise in sea level would also destroy many coastal marshes, severely damage many important fisheries dependent on those wetlands, and would also threaten freshwater supplies through the intrusion of sea water into aquifers and the upstream movement of saline water in rivers.

Dwarfing even these substantial coastal impacts, the global warming will inevitably have profound effects on world agriculture. Annual increases in the global harvest have become much less dependable in the last decade and are likely to become still more uncertain as rapidly changing climate makes many crops inappropriate in the places where they are now grown. Climate zones will shift rapidly, perhaps as much as 10 to 60 times faster than they did as the last ice age ended (Schneider, 1988).

One might think it would be relatively easy for farmers to switch to crops adapted to new conditions or to begin farming in newly favourable areas. Unfortunately, things are not that simple. First of all, farmers (like the rest of us) tend to be conservative and will not rush to plant different crops at the first sign of drought. Second, crop species or varieties that thrive under the new conditions may not be available, or may be economically less desirable, or may require unfamiliar new techniques or equipment that is unavailable.

We hardly have to detail the political and social problems involved in, say, moving Iowa corn farming into Canada or moving Canadian wheat production into areas now occupied by taiga. The notion of farms and farmers chasing belts of climate over the face of the planet might be farcical if the situation were not so serious. And this picture neglects an obvious barrier to the success of such an enterprise in many areas. Very often the soil under displaced climatic zones will be unsuitable for the

sort of agriculture practiced in the old zone. In some places, new soils will be generated by new climates, but the time required will be thousands of years. And, of course, there is the overall problem of the uncertainties about exactly how the climate will change, and how long a new regime will last, all of which makes moving farming operations a gigantic gamble at best.

The conservatism with which society can be expected to face the possibility of climate change was beautifully exemplified by the disastrous North American drought in 1988. Even though knowledgeable scientists have pointed out for more than a decade that such droughts were the *sort* of events that would probably occur as the climate warmed, no concerted social effort was generated by the drought either to prepare the agricultural system for rapid change or to take steps to slow the warming process. Instead, there was much carping about how the drought might have been unrelated to the warming (true enough) and assertions that society should wait for "proof" that the greenhouse effect was causing trouble (since science *never* offers "proof," it would be a long wait). No significant progress was made, even though many steps, such as phasing in a high tax on gasoline, would carry numerous benefits even if the climate never changed.

With that sort of reaction in as highly educated, relatively science-oriented a society as the United States, one can imagine how slowly more traditional societies will respond to the threat of climate change. Even if that change eventually produces, on the average, more benign climates over Earth's land surface, substantial losses in agricultural production during a phase of rapid change are virtually certain.

In the Soviet Union, ironically (given the widespread expectation of beneficial changes), agriculture is likely to suffer *more* than that in western nations during a period of rapid change. Soviet society is more conservative, and its agriculture is much less well developed. In the 1930s and 1940s, the intellectual equivalent of "creationists" won ascendancy in Soviet science under the aegis of

Trofim Lysenko. The science of evolutionary plant genetics, the very foundation of modern agriculture, was destroyed and its leading lights (including such first-rate evolutionists as Nikolai Vavilov) imprisoned or killed.

That occurrence dealt Soviet agriculture a blow from which it has yet to recover and placed its future very much in doubt. Even the strong communities of evolutionary geneticists in the West will be hard-pressed to supply the necessary new strains of crops for their own nations if climates change at predicted rates - with poleward movement of climate zones of as much as 10 kilometers per year in worst-case scenarios.

Problems for developing nations could be equally or more severe. In India, for example, the intensity and timing of monsoons may be altered, quite likely causing difficulties with agriculture regardless of the direction of change. For instance, unless huge sums are invested in water storage and flood control, more rainfall, rather than being beneficial, could simply result in more damaging floods. Unfortunately, the fertilizer-sensitive "miracle" crop strains on which the green revolution was based often show more variation in absolute yield in response to changed environmental conditions than do the traditional varieties they have replaced (Schneider and Mesirow, 1976). This will increase the vulnerability of many developing nations to environmental changes through enhanced fluctuations in yield.

The world does not, of course, enjoy food security now. A recent study (Kates et al., 1988) indicated that, with equal distribution and no grain-feeding of animals, the 1985 global harvest would have been sufficient to feed an essentially vegetarian diet to 6 billion people. A South American diet (about 15 percent animal protein) could be supplied to some 4 billion, and a North American diet (about 35 per cent animal protein) to 2.5 billion. But the 1988 harvest was about 10 per cent *smaller* than the 1985 harvest (and the population was 5 per cent *larger*). Moreover, there is no sign that people in rich or poor nations are ready to distribute food equally, nor of any trend toward using less of the

grain harvest to produce animal products. In 1988 the United States, on which many nations partially depend as a source of grain imports, consumed more grain than it grew for the first time since World War II. Most importantly, the world's population is projected to pass 6 billion before the turn of the century.

Of course, the next few years may see a return to good weather and bumper harvests. Computer models predict that the intensity of droughts and the frequency of mid-latitude heat waves and of severe cyclonic storms will increase - not that all summers in the north temperate grain belts will be hot and dry or that all hurricanes will be gigantic and deadly. We are loading the dice against ourselves, but that doesn't mean we'll lose on every toss. Furthermore, food production no doubt will increase again, especially as supplies fall below demand, prices rise, and farmers can afford to use more fertilizer, drill more wells, bring marginal land into production, and so on.

Such a turn of events might save many lives in the near term by restoring some measure of food security in the form of grain surpluses and avoiding steep food price rises that would inevitably increase death rates from starvation among the poorest. But it would also lighten the pressure on rich and poor alike to take the actions needed to slow the greenhouse warming trend and gain some time for societies to make adjustments to the inevitable changes. In the absence of such actions, the outlook for the longer term - from the turn of the century on - becomes far less encouraging.

Global interdependence

The appearance of global environmental problems, of which the greenhouse warming is but one - though perhaps the most dramatic and threatening - is an indication of the level of human dominance of the planet. Acid precipitation and the depletion of stratospheric ozone are others; while their causes are more closely associated with heavy industrialization, their impacts stretch far beyond

industrial regions. Solutions to these problems must be international as must the management of the global warming dilemma.

The actions necessary for both delaying the onset of global warming and adjusting to the changes it brings are imperative for maintaining Earth's habitability - its ability to support satisfactorily a large-scale industrial civilization for more than a couple of generations (Brundtland, 1988). And those actions, unlike measures normally taken by individual nations to meet their energy needs or correct environmental problems, must be made in concert by *all* nations, because of the growing economic interdependence among them and because they all contribute to climatic change.

Increasing international economic ties and the movement toward a world financial system are more benign aspects of global interdependence. The political world lags behind these realities; nothing resembling the needed comprehensive international coordination of actions affecting the global commons is visible. Yet, behind the scenes, an increasing number of problems has come under international regulation of one kind or another, with environmental regulation often leading the way. At this point, the persistence of war as a means of settling disputes seems increasingly anachronistic, and more leaders seem to recognize, at least implicitly, that a major war is simply unaffordable today. Interestingly, most of the nations engaging in war today seem to be among the least modernized and most alienated from the world community.

Addressing global problems

What are the essential actions that must be taken by the world community to preserve Earth's habitability? First, of course, population growth must be halted humanely, by limiting births in both rich and poor nations, and a slow *decline* in human numbers initiated. Second, the rich nations must drastically reduce their levels of consumption and deploy technologies that extract every last possible drop of

benefit from each unit of energy that is used. Third, the rich countries must help poor countries to develop without crippling the capacity of Earth to support civilization. This includes preserving and restoring their forests and other natural ecosystems to the greatest possible extent. Finally, a world economic system must be created by both rich and poor that is both sustainable and gives newly developed nations sufficient access to industrial products to give their citizens a decent life. It is no small task.

Reversing population growth

Population control must be the first priority for civilization, not because it will produce quick results, but precisely because it will take a long time to achieve them. It is required in rich nations because of the enormous per-capita impact of their citizens on the environment and resources of the planet. Commercial energy use per capita is an approximate index of the environmental destruction caused by an average individual. By that measure, the birth of each American baby is estimated to be some 35 times the disaster for Earth's life-support systems as the birth of an Indian baby and 140 times that of a Bangladeshi baby.

Population growth today is slow in rich countries (even halted or negative in some), and the average person is older, so the transition to a declining population could be achieved relatively soon. Because the per-capita environmental impact of each citizen is so high, population shrinkage in the rich nations could provide a relatively quick and painless way to relieve the human assault on the environment - assuming that per-capita impacts of the rich were not increased and the overall reductions due to fewer rich people were not swamped by increased impacts generated in developing countries.

The population situation in developing nations is quite different. In the past, we have often said (to oversimplify) that overpopulation of the rich threatens the habitability of Earth, while rapid population

growth in poor nations is a major factor in keeping those nations in poverty. Now we would add the following : Because of the immense numbers of people present and projected for the future in developing nations, any substantial industrialization of those nations along traditional lines would quickly transform them into a major threat to global habitability - as the CO₂ dilemma makes very clear.

The momentum of population growth in developing nations (the amount of time required to halt population growth, let alone to reduce the population size substantially) is awesome. India's situation is illustrative. Suppose India *did* reach replacement reproduction in 2025. With that "success", the population would continue to grow until almost the end of the next century, increasing from about 820 million today to some 2 billion - the number of people who lived on the entire planet when we were born in the early 1930s!

These and other standard demographic projections, of course, do not consider the possibility of a tragic rise in death rates. Some local rises have already occurred, and it is entirely possible that starvation, disease, general ecological breakdown, and conflict will dramatically raise death rates around the world before the 21st Century gets very old.

The impact of a population on the environment is the product of three multiplicative factors: population size, an average person's affluence (consumption), and the environmental damage caused by the technologies used to achieve that affluence (Ehrlich and Holdren, 1971; Holdren and Ehrlich, 1974). The overall impact of a population can be reduced by shrinking the size of the population, by lowering per-capita consumption, by adopting more environmentally benign technologies, or by some combination of the three factors. If any of these three is allowed to continue increasing (or worsening), no reduction in the others will solve the problem in the long term.

Re-shaping the industrial societies

What is crystal-clear today is that, with respect to

even the medium-term carrying capacity of Earth for human beings (Vitousek et al., 1986; Ehrlich et al., 1989), the collective human assault on Earth's life-support systems is enormously too high. The impacts of rich countries are so great, in fact, that these nations should be called not developed, but *overdeveloped* (Ehrlich et al., 1977) or perhaps, more accurately, *maldeveloped*. If Earth is to remain capable of supporting a large-scale industrial civilization, and if the less-developed nations are to have any chance of participating at all in the benefits of industrial civilization, the maldeveloped nations must now undergo a dramatic corrective process (Ehrlich et al., 1977). The rich must greatly reduce the pressure they place on the resources and life-support systems of Earth. They must come to understand that the kind of economic growth they prize so much is the disease, not the cure.

There are several ways that this lightening of pressure could be accomplished in addition to population shrinkage, and some of them are already under way. As the global economy becomes increasingly integrated, some industrial activities are being redistributed to less-developed countries, as businesses are attracted by lower wage rates and less regulation (unfortunately including less environmental regulation). This trend could be encouraged, but the goals of improving wages and working conditions, distributing the benefits more evenly, and raising environmental standards in poor countries must be part of the process. Otherwise, the ultimate consequences of a global migration of capital in perpetual search for cheap labor would be poverty for all working people. This standards-lowering competition would drive wages, environmental protection, and social insurance down to the least common denominator (Daly and Cobb, 1989). Even the capitalists would suffer awash in a sea of poverty and thus disappearing markets.

The movement of industry into developing countries *could* be a vehicle for establishing more environmentally benign technologies for manufacturing the goods needed in all countries and for contributing locally to development processes. That would happen, however, only if appropriate incen-

tives and regulations were in place to lock in energy-efficient production technologies. Unfortunately, so far, what planning has occurred in this process has been limited to each industrial corporation seeking profits. If that planning could somehow be linked to national and regional development planning, the outcome could be much more beneficial to the world economy. The net result could be less concentrated industry in rich countries (thus reducing the local environmental damage they do) and more in the poor countries.

Within the rich countries, environmental damage could be reduced by more direct actions striving to diminish all three of the impact multipliers simultaneously. Not only should the maldeveloped nations make an effort to shrink their populations, but also to reduce their consumption of resources and shift rapidly to more benign technologies. This is not the place to detail the kinds of changes needed (see e.g., Ehrlich et al., 1977, Daly, 1977), but in broad outline they have long been known.

Top priorities must be to increase energy efficiency and conservation and to deploy substitutes for fossil fuels, especially for coal. In most industrial nations, transport systems will need an overhaul: mass transport will have to replace much of today's automotive commuting, and cities should be reorganized so that people can live closer to their work places. Electronic communication can be substituted for much business travel. In general, buildings, home and business appliances, automobiles, and other manufactured items should be designed with durability and energy efficiency as major features, and constant style - and gimmick-driven changes largely suppressed. Throw-away plastics should be made biodegradable and their use minimized.

From the standpoint of the critical need to preserve biotic diversity, as well as to preserve prime farmland, the opening of new land for development must also be halted. Bringing new land under cultivation in rich nations must also be halted. That land will be mostly marginal for farming, and gains in agricultural production will often be temporary and the cost in damage to life support systems high.

Most importantly, the rich nations must stop putting pressure on the forests of the tropics. The importation of tropical hardwoods, paper products based on woodchipping of rain forests, and beef grown on pastures carved from those forests must be terminated.

One must note that moving away from the "perpetual growth, throwaway society", does not require creation of an austere, hairshirt society. Beer can be kept just as cold in a simple, long-lasting, energy-efficient refrigerator as in a model with the latest gimmicks and styling. Light, durable, fuel-efficient vehicles can provide just as much transportation as heavy gas guzzlers. Redevelopment of slum areas can replace the paving over of productive farmland or natural ecosystems that supply society with vital life-support services. With cleverness, few creature comforts need be lost, health and life expectancy could be improved, and entrepreneurs would have abundant opportunities to make money as the transition is made (Ehrlich et al., 1977). The biggest challenge will be adjusting the economic system so that it is not so dependent on material throughput (Daly 1977) and assuring that all people are able to play an active role in the economic life of society (Pirages and Ehrlich, 1974).

In short, there will have to be a social revolution in rich nations, and attitudes toward object-based affluence must be drastically altered as a transition is made from a "cowboy economy" (Boulding, 1966) to a sustainable society. The transition should be preceded and accompanied by a self-conscious evaluation of what kinds of industrial production and what products are truly useful and worth having.

This will not be an easy task for the rich nations; indeed it will only be possible if people can be made to see what the alternatives are. That in itself represents a tremendous challenge, since in both its biological and cultural evolution our species has not, until very recently, needed to perceive and react to gradual environmental trends (Ornstein and Ehrlich, 1989). The public and decision makers must learn to interpret the sometimes subtle

indications of slowly developing problems. That squiggly line on a graph showing rising levels of odorless, invisible CO₂ in the atmosphere represents a threat more lethal to society than terrorists on airline flights. Unless society learns to recognize and react to such signals, it will be impossible to initiate appropriate action.

New goals for development

Considerable responsibility for the world's future, of course, rests with the developing countries. In their own interest, to say nothing of that of the entire planet, they must reaffirm their commitments to halt their population growth. Every additional person can be viewed as lowering the eventual level of per-capita development that a nation can achieve. Equally important, developing nations must carefully rethink their development goals.

It would be a catastrophic mistake for those nations to strive for the kind of industrial overdevelopment from which the rich must now retreat. The environmental costs would be more than they or our planet can afford, and there probably also are limits to potential markets for products. There are other forms of development than heavy industry, however. One that has been neglected by much of the developing world is agricultural development; too much emphasis has been put on production of export crops for the rich and too little on improving crops and farming systems to feed local populations. Yet, with the exception of a few unusual "city-states," which survive through industry and trade, no country has successfully developed without first establishing a sound agricultural economy.

It is long past time to re-examine the old industrial model of development and come up with a better one. The entire world should aim for what has been called *sustainable development*. This would include an emphasis on ecologically sound agricultural development, in industrial as well as less developed nations. Emphasis also should be placed on meeting basic needs for health care and

sanitation. Some maldeveloped nations have tended to overemphasize expensive, high-technology treatment for diseases of older people, while neglecting basic care of the poor, including infants and children. Education, especially for females, is critical; it also is a problem today for both rich and poor nations. And improved health, reduced infant mortality, and education of women seem to be essential prerequisites for effective population control.

In underdeveloped rural regions, attention should also be given to extension of electrification and improvement of farm-to-market roads and communications. As far as possible, of course, all this should be accomplished by maximizing the efficiency of use of limited resources and care to avoid both environmental damage and cultural disruption.

Everything feasible should be done to restore damaged ecosystems, especially the replanting of deforested areas. It would be a great benefit for all people if many millions of hectares in both poor and rich nations could be replanted with trees. It would create a "carbon bank" that would help slow global warming (Postel, 1988). And, even if non-native species were used, forest plantations would help stem the tide of extinctions by removing pressure for extracting fuelwood from remaining fragments of virgin forests (Ehrlich and Ehrlich, 1981). New forests would provide other benefits as well, in the form of ecosystem services - halting desertification, preventing flooding, etc. (Ehrlich and Ehrlich, 1981).

Planners must ensure, however, that the costs are shared as well as the benefits, and that the rights of poor people now living on marginal, deforested lands are protected. The rich should not ask them to bear heavy costs as humanity attempts to restore a significant portion of Earth's original forest cover. And people must clearly understand that sustainable development does not imply perpetual growth in the economy - that indeed a steady-state economic system (in terms of physical flows), sustainable over the long term, must be reached, and much sooner than most economists imagine.

Such development goals, of course, are not likely

to be adopted by developing nations unless they can be assured by cooperative international agreements of both much more aid in the process of development and reasonable access to necessary industrial products that cannot be locally produced. The entire international economic system would have to be totally revised so that nations that are not primarily industrial nonetheless could participate fully in its benefits. A good start could be made if the rich countries simply found ways to "forgive" most or all of the gigantic debts of developing countries, most of it incurred with the misguided goal of moving toward maldevelopment (and some of it skimmed by rich people in those countries and redeposited in the banks that made the loans!). Much of that debt could be "swapped" for various conservation projects and commitments to ecologically sound, labour-intensive agricultural programmes.

Indeed, eventually a system might be established that taxed industrialization to subsidize non-industrial regions and nations that provide markets and raw materials (just as less industrial areas within developed nations are supported in part by the industries in other areas). Some non-industrial nations or regions will provide life-support services by maintaining preserves for natural ecosystems, whose benefits can be shared by the entire globe. It is hardly fair to ask the Brazilians alone, for example, to pay the price of not exploiting their tropical rain forests in order to protect the global climate and a vital part of Earth's storehouse of biodiversity. That should be, at some level, an international responsibility.

Economist Herman Daly of the World Bank has suggested (*pers. comm.*) one plan that, if instituted, would provide a start in sharing the burden of global environmental problems equitably. A "Carbon Dioxide Fund" could be established into which nations paid a tax according to an estimate of the amount of CO₂ they injected into the atmosphere, and from which they could receive payments or credits on the basis of how much they absorbed. Countries would pay into the fund for the fossil

fuels they burned, and be paid from it for the trees they planted.

Toward the future

Rich nations must lead the way by correcting their maldevelopment - redistributing industrial activities and benefits, while mitigating impacts and reducing populations - and make clear their intention to assist poor nations. They must, for example, help the poor to put in place energy technologies that will make the least contribution to the greenhouse warming. It would be preposterous for the rich to expect China and India to limit their use of coal without providing an economical alternative energy source (or at least much more efficient production and end-use technologies). Basically, the rich must pledge to meet the poor more than half way in the struggle to preserve civilization, and collaborate with them in reorganizing economic relationships between nations to create a sustainable and equitable global economy.

Without such a commitment from the rich, and action to back it up, the future of *Homo sapiens* looks grim indeed. There will be a few more decades, perhaps, of frantic growth. Some poor nations might continue emulating the rich, trying to develop, using the same old inefficient, environmentally malign technologies. When the world finally awakens to its dilemma, there then might be an attempt to correct that maldevelopment also. But, in essence, developing a nation like China or India a second time, by switching from malign to benign technologies, would almost certainly require more resources than could be brought to bear, and would almost certainly be too late. The outcome would be a collapse of civilization as ecosystem services failed and starvation, plague, and warfare wiped out much of humanity.

Humanity has gone so far down the wrong path that avoiding such a collapse will require a most difficult transformation of society. New ways of thinking will have to become pervasive; racism,

sexism, and religious prejudice will have to be abandoned as people struggle to preserve the habitability of the entire planet. That economic growth at a global level must be halted, with the physical economies of the rich nations shrinking to allow for the expansion of the economies of the poor one, will have to be widely recognized. For their part, the developing nations have an opportunity to find new, less destructive paths to development. Above all, people everywhere must realize that humanity's most serious problems can no longer be solved locally, regionally, or nationally; only globally.

The idea that all these changes can happen, of course, will be called "naive," "idealistic," or "utopian." But humanity is now at a crossroads where the only practical ways out of its dilemma are ones that "practical" people have long scorned. Perhaps the vision of a better future will allow us to overcome our prejudices and old ideas and work together. Most of us are unwilling to sacrifice very much for unknown people in distant lands, or even for the poor in our own countries. But almost all of us are willing to make great sacrifices for our children and grandchildren. And it is their lives and future that are at stake.

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