Equity and Sustainability in the Greenhouse:
Reclaiming our Atmospheric Commons

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Preface

In India, debate on environment and development is often focused on the controversies over development projects (such as Narmada and Enron) or on the conceptual issues (such as alternative development) that spin-off from them. The debate and its participants (with certain exceptions) seem to be so overwhelmed by the enormity of these immediate and proximal issues that many critical international and multilateral environmental issues are kept at a distance in a respectful but dis-interested manner. This phenomenon is not typical to India but many Southern countries, for one reason or the other, fail to pay adequate attention to the international environmental issues. Some of these issues such as forests, biodiversity, and biotechnology are perceived as not-too-technical and are debated actively. However, some international and multilateral issues are often perceived as too-technical and too-esoteric to engage with, the best example being the issue of climate change. Though the Center for Science and Environment at Delhi had published an excellent monograph on the issue as early as 1991, the activists and researchers in India, by and large, failed to maintain this initial advantage.

The issue of climate change* is, in a way, an archetypal enviro-development issue in which many Southern countries are bound to pay a heavy price for the problems created by unsatiated Northern appetite for economic growth. The impending climate change certainly has some localized implications which, for example, include submergence due to the rising sea-levels of large parts of the small-island countries (such as Maldives) as well as of thickly populated low-lying sea-front areas in many Southern countries (such as Bangladesh). But it is apprehended that the devastation caused by the rising temperature will be much more wide-spread in the tropical and near-tropical regions in the South. The rise in average temperature will make these regions less habitable if not unhabitable for most of the native plant and animal species that serve as bases for livelihoods of Southern people. Such a calamity would jeopardize the economic viability and political stability and, hence, would engender the very foundations of historical civilizations in these regions. The wealthy Northern countries mostly situated in the temperate zones, which will be spared of such devastating effects, will, nonetheless, experience a severe shortage of resources to continue their economic growth.. As a result, rather than coming to the aid of the Southern countries, they will most probably concentrate on protecting their own interests by exerting economic and political pressures on Southern countries and, if necessary, by resorting to direct military action and repression to ward off problems like possible invasion by desperate Southern environmental refugees.

Thus, the issue of climate change has grave international implications, and, hence, is a real global crisis to be resolved through global effort. Though there is some uncertainty over the exact time-frame of the impending impacts, the politics surrounding the international efforts to address the global crisis makes it an urgent issue for the Southern countries. Unfortunately, the Northern governments and the bureaucracies of the multilateral bodies dominated by the Northern interests have been successful in marginalizing a meaningful Southern participation in the resolution of the crisis by obfuscating it behind the mist of

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* The problem of climate change is also known by other terms such as 'Global Warming' and 'Greenhouse Effect'. Essentially, these terms describe physical and socio-economic impacts of changes in atmospheric chemistry caused by rise in concentrations of gases such as carbon-di-oxide, ozone, nitro-oxides, chlorofluocarbons, etc. These gases, called Greenhouse Gases (GHGs), are created by natural bio-chemical processes as well as human activities and are emitted to the atmosphere. The biosphere (especially vegetation on the Earth and the Oceans) has capacity to absorb some of these gases to certain extent. However, when the levels of emission exceed these absorption capacities, the concentrations of greenhouse gases in the atmosphere start rising. These rising concentrations result in excessive trapping to solar heat, causing increase in the average temperature of the earth. This increase gives rise to a set of complex chain reactions in the biosphere which have equally complex impacts on human cultivation. Though there is a near-total scientific consensus on the fact that the process of global warming is in progress, there is still some uncertainty over its timing and the exact nature and levels of its physical and socio-economic impacts.

technical and economic esotericity. Functioning of various Working Groups of the Intergovernmental Panel on Climate Change (IPCC) betrays such a bias against the Southern countries. This bias is reflected in their sole over-emphasis on apparently neutral, highly sophisticated, and costly technological and economic policy formulations. Essentially, these formulations focus on the present and future of the issue instead of its history, on the corrective measures instead of fundamental policy changes, and on maintaining economic and political status-quo instead of bringing in elements of sustainability and equity. The main intention is to avoid the historical responsibility of the problems and to focus on its correction in a manner that would maintain the prevailing advantages enjoyed by the Northern countries. Unfortunately, such efforts are aided and, in turn, legitimized by many vested interests of the Southern origins. These include: (i) the North-trained Southern experts and bureaucrats who are part of international and multilateral institutions and who are sold on the Northern "logic"; (ii) politically naive Southern bureaucrats and scientists who get dazzled by the sophistication of Northern scientific tools and gadgetry; (iii) ill-informed and dis-interested Southern politicians with fragile integrity whose sole aim, often, is to enjoy foreign jaunts; and (iv) a new genre of mercenaries called Southern NGOs who readily play the Northern ball in return of cash-rich contracts, projects, and international assignments.

In this context, work of Dr. John Byrne stands out as unique. He is a distinguished energy and environmental policy scientist of international repute and is involved in the working of the multilateral bodies dealing with the issue of climate change in different capacities. With the firm and intense commitment to values such as equity and justice, he has evolved an incisive analysis of the issue which helps expose and establish the culpability of Northern societies beyond doubt. Dispelling the mystique of the technology and economics, he has also indicated an outline of an innovative policy approach that the Southern countries should adopt in the interests of their own people. Prayas had organized Dr. Byrne's lecture to introduce Indian intellectuals and activists to his analysis and his policy approach to this critical issue. It is hoped that this booklet will help spread this awareness and understanding to a larger audience.

It is necessary to remember the outstanding person who had chaired the lecture–late Mr. R. D. Aga, the then, Chairman and Managing Director of Thermax Ltd.. Prayas had invited him not in the capacity of an industrialist but as a professional who possessed vision to rise above the immediate professional and commercial interests and to come forward to contribute to what is going to be a common fight of the Southern people. We take this opportunity to pay our respect to the memory of late Mr. R. D. Aga.

Dr. Subodh Wagle
Member, Prayas Energy Group

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It is a great pleasure to present my Center's work and ideas in the historic city of Pune. I want to express our gratitude to Prayas for providing this platform and to Mr. R.D. Aga for agreeing to chair this lecture. I also want to thank all of you, citizens of this great city, for attending this lecture and expressing concern about this truly global problem.

The focus of my remarks is the risk of climate change induced by human activity. Commonly termed "global warming," this phenomenon is one of several transformations of the natural world that are traceable to our exploitation of the Earth's processes and resources. I will go into this problem in detail in a few minutes, but let me first highlight a few points:

- Our atmosphere serves as a greenhouse that keeps the planet warm enough for life as we know it (it would be about 35°C colder without this effect).
- However, we can overheat the planet by changing the chemistry of the atmosphere.
- This is not merely a physical concern but a social and political one as well. If the warming recently projected by a UN-sponsored panel of 2000 scientists is realized in the 21st century, a significant portion of Bangladesh could be submerged, affecting this society of 105 million severely.
- The countries that launched the world into a risky relation with climate are those of the North. However, the countries and people in the greatest jeopardy are those of the South.
- We have no choice but to address this social and political problem. In our lifetime and those of the children born to this generation, we will either:
- Ignore the problem and find out later the results of a risky experiment that may adversely impact two-thirds of the human population.
- Or, we will commit ourselves to stop the experiment, and agree to treat our atmosphere as a *commons* rather than a *commodity*.

The Main Hurdle: The Industrial Ideology of Progress

Responding to the problem of global warming will not be easy. For the past 200 years, industrial societies of the North have depended upon a basic formula for resolving social problems – namely, wealth and economic opportunity, if necessary, at the expense of others. With rising economic growth and improved technology to expand production capacity, Northerners have assumed that the human condition, or at least their condition, could be bettered. This strategy of "more as better" has steadily attracted adherents in the industrial era, and, especially in the final decade of this century, appears poised to become a worldwide ideology. While improvements in health and economic security have accompanied societal commitments in the North to this "more as better" ideal of progress, the world is now confronted with environmental threats that are uniquely the result of this success.

The industrial idea of progress assumes an infinite ability of nature to serve as a reservoir for our wastes. But the risk of global climate change that we now face contradicts this assumption. The environmental

impacts of industrial progress are no longer limited to sporadic acts of natural disturbance or degradation. Rather, the very structure of nature, including the chemistry of the atmosphere, is being subjected to the design principles of industrial development.

Effect of Industrial Production and Consumption Structures on the Atmosphere

Evidence that the world industrial system's capacity to produce and consume is affecting the structure of the atmosphere takes many forms. I will briefly review two examples: one is urban air quality and the other is transboundary sulfur dioxide pollution.

Circulating through an industrially manufactured cloud of pollution (most of it energy-based), urban air worldwide exacts the price of modern existence – human health threatened by the involuntary, heretofore, life-giving act of breathing. The World Health Organization (WHO) estimates that 65% of the world's large urban populations breathe air with health-threatening concentrations of sulfur dioxide. As depicted in Figure 1, 9 of the world's 15 megacities routinely experience SO_2 pollution that is unhealthy under World Health Organization (WHO) guidelines. Eight of these megacities, including Bombay and Calcutta, are in the developing world. (It should be noted that SO_2 is a greenhouse gas linked to global warming, as well.)

For another urban air pollutant studied by WHO – suspended particulate matter, the situation is even worse: concentrations of SPM exceed standards for healthy respiratory and heart function for 70% of the world's large urban populations. As Figure 2 indicates, 12 of the world's 15 megacities have concentrations of this pollutant that are routinely in violation of WHO standards for healthy air. Eleven of the 12 most polluted megacities (in terms of SPM concentrations) are in developing countries including Bombay, Calcutta, and New Delhi.

Many of the cities with the worst levels of pollution are in developing countries and especially in Asia. But it should be kept in mind that many of the dirty industries responsible for this pollution are producing goods for consumption in wealthy Northern countries or providing profits to multinational companies of the North.

As the centers of industrialization, large cities serve as a spatial network of development and pollution. Urban success in industrial development now assumes a concurrent chemical change in the air we breathe.

A second example of society's increasing impact on the environment is the manufacture of "acid rain," a modern pollutant threatening forests in several parts of the world. The geographic scale of acidic damage and the particular chemistry of the acids involved are distinctive to our technological age. Acid pollution has become so widespread that we are, for all intents and purposes, engaged in an industrialization of the atmosphere.

A vigorous SO_2 import-export process pervades industrial regions with the atmosphere serving, in effect, as a means of spreading the costs of industrial development across wider and wider areas. As ***Table 1*** indicates, some countries, such as Norway, are poorly positioned for this exchange; while others, like the UK, are poised to be big winners.

In effect, social progress on our present path anticipates treating the atmosphere as a commodity to be used for its pollution-transporting properties. Partly in recognition of this economic value of the atmosphere, the US has set up regional emissions trading markets. In addition to selling futures in crops and domestic animals, the Chicago Board of Trade now also executes contracts to pollute urban air. SO_2 emissions rights sell at about $200 per ton. Spot and futures markets for sulfurous air are also emerging. This explicit market for air pollution trading is a second gauge of the extent of commodification of the lower atmosphere.

Another measure of the importance of the atmosphere as a waste dump under the present development paradigm is the fact that industrial countries annually manufacture more tons of sulfur dioxide pollution

(100 million tons of sulfur per year) than aluminum and plastic; and that the annual emissions by industrial countries of carbon dioxide (approximately 5 billion tons of carbon per year), the principal gas involved in the greenhouse effect, is four times the world production level, in tonnage, of iron, steel and copper combined.

It is widely assumed, including in many countries of the South, that such pollution is a necessary price of modern economic development. But is this true? Specifically, is it true that economic development accompanies rising pollution levels, particularly in the South?

The Political Economy of Unequal Development

Despite our massive use of the natural world as a waste dump, we are far from meeting even the basic needs of the human community. Indeed, our era of progress appears to have institutionalized, rather than eliminated, poverty.

In discussions of poverty and social inequality, the role of energy is often neglected. Yet, access to and use of energy is often fundamental to human existence and livelihoods. Further, energy systems play a key role in a society's relation with the natural environment, specifically whether our relation with nature is sustainable or destructive. The present energy system, on which industrial development depends, is inadequate to the task of meeting human needs. Although worldwide in organization, the current fossil fuel energy regime serves the needs of only, roughly, one-third of the world's population. As Figures 3 and 4 show, the major fossil fuels are consumed by the wealthy countries via supply systems that extract energy resources from throughout the world. Coal and oil currently account for nearly 70 percent of world commercial energy consumption, but less than one-fifth of this consumption is dedicated to the needs of the South where two-thirds of the human community. With the energy needs of developing countries expected to double in 30 years, neither the resource base nor the technology base exists to support Southern development. If we consider the trillions of dollars (the equivalent of tens of lakhs of crores of rupees) invested in the present world energy system, the need to triple it to promote a more equitable development pattern worldwide, and the declining availability of key energy resources (especially oil), there can be little doubt that systemic energy failure looms in our future unless we change course.

Our unequal energy order is matched by, on equivalent scale, socially unequal use of the environment. The key source of worldwide air pollution is energy-intensive industrial development. The industrial countries account for most of the air-borne sulfur oxides, nitrogen oxides, carbon monoxide and hydrocarbons. These emissions have been linked to asthma, bronchitis, emphysema, pneumonia, heart disease and skin cancer (see Table 2). Industrial countries also account for virtually all of the chlorofluorocarbon (CFC) emissions that are responsible for the "ozone holes" in the upper atmosphere. CFC is a synthetic energy input made from carbon fuels mainly to energize refrigerant and air conditioning technology in wide use in the North. In this respect, the North consumes such environmental gifts as clean air and unpolluted water at rates far in excess of nature's regenerative capacity. While we may argue over the timing of system failure, it should be clear that the existing world energy order is socially and environmentally problematic and its viability, if not its longevity, is in doubt.

Interrelated to the highly skewed patterns of energy resource utilization and environmental degradation is the pattern of unequal economic conditions and security. As Figures 5, 6 and 7 suggest, the distribution of economic power parallels that of energy and environmental consumption. These three figures vividly show how the world looks in terms of the distribution of industrial capacity, capital accumulation and purchasing power. For example, first, as Figure 5 indicates, all of the nations of South America and Africa together do not have manufacturing output equal in value to that of the UK. In the case of commercial capital (Figure 6), the year-end deposits in the Bank of America (ranked 50th in size in the world) exceed the combined GNPs of 39 African countries representing over 325 million human beings (two-thirds of sub-Saharan Africa's population). In effect, sub-Saharan Africa, from the point of view of commercial capital,

essentially does not exist. Finally, the combined purchasing power (Figure 7) of South America and Africa is about half that of a single country, Japan.

The cumulative result of 200 years of socially unequal and environmentally destructive development is unsettling. We have failed to meet the needs of the present generation and we are compromising the ability of future generations to meet their needs by the continuation of our destructive relationship with nature and each other.

The Political Economy of Climate Change

Industrial societies now, or in the near future, will possess the capacity to alter the climate itself, which will have a profound effect on human society and on the biological world as a whole. The prospect of global warming is the inescapable threat of unchecked industrial development into the 21st century.

The Intergovernmental Panel on Climate Change – a body co-sponsored by the UN and the World Meteorological Organization–has completed its *Second Assessment Report* in which it concludes that the mean surface temperature of the Earth has increased. Most of the warming has occurred in the 20 century with the last 15 years being the warmest on record. The rate of warming in this century is greater than any in the past 10,000 years. The IPCC has concluded that "the balance of the evidence suggests a discernible human influence on global climate."

Of course, there are uncertainties surrounding the issue of global warming. But for me, the question is not whether we can precisely establish its magnitude, or predict its future course; rather, it is whether and under what conditions we will choose to avoid, or at least mitigate, the threat of global warming. Posed in this way, the issue is really a social one: how would societies have to change in order to suspend the Experiment in Global Climate Change and return to a less risky relation with the atmosphere.

As a first step in looking at this question, I'd like to put the matter in perspective. Most people cannot easily envision something called the atmosphere and so it's hard to imagine having an effect on it. But the atmosphere is a rather fragile life support system, certainly not an infinite reservoir for waste. In fact, if we take the troposphere approximately the 15 km of atmosphere where the Earth's weather is mostly determined and put it in a sphere (at actual temperature and pressure gradients), the result would be something like what is depicted in Figure 8.

Human activities, especially in the Northern countries over the last 200 years, have released alarming levels of so-called 'greenhouse' gases (including CO_2, SO_2, NO_x and CH_4), mainly as a result of fossil fuel combustion. These gases act like a greenhouse trapping solar heat in the atmosphere. In excess of 7 billion tons of these gases are annually released. This emission rate is well above nature's capacity to absorb them (e.g., CO_2 can be absorbed by growing forests) and are accumulating in the atmosphere. The principal source of greenhouse emissions is the Northern tier of industrial counties (Figure 9).

It should come as no surprise that annual releases of billions of tons of greenhouse gases are affecting the small sphere of air depicted in Figure 8. In fact, as Table 3 summarizes, the basic chemistry of the atmosphere has changed as a consequence of 200 years of industrial development.

Sustainable and Democratic Relations with the Atmosphere

The most important greenhouse gas (GHG) is CO_2. It accounts for more than three-quarters of world GHG emissions. If we are to halt the Experiment in Global Climate Change, emissions of this gas will need to be dramatically reduced. To establish a benchmark for change, we can consider the absorption rate offered in nature. If we embrace the principle that the biosphere is for all living things, and specifically that no human being is entitled to use the biosphere's CO_2 absorption capacity more intensively than another, then it is possible to figure out, at existing world population levels, how much CO_2 can be emitted on average per person without exceeding the absorption or "sink" capacity of the Earth. By multiplying that

figure by, say, the population of India and the U.S., you can find each country's "fair share" of the biospheric sink for CO_2. Figure 10 shows the "fair share" and actual CO_2 emissions for the U.S. and India.

It is immediately evident that Americans are emitting a far more of this gas than their "fair share." Indeed, Americans are emitting about seven times the sink allotment allocated to the country on this basis. By contrast, India, at this time, releases substantially less CO_2 per person than its "fair share" allotment. Performing the same calculation for China, we learn that the country is using less than its "fair share" despite its heavy use of coal. In fact, all industrial countries emit substantially more than their fair share and most developing countries emit less.

Approximately, the Sustainable CO_2 Emission Rate (SCO_2ER) is estimated to be about 2.72 to 3.3 tons per person per year, at the 1990 level of world population.[1] Figure 11 shows per capita CO_2 emissions of various countries compared with the Sustainable CO_2 Emission Rate. The width of each block representing a country corresponds to its proportion of world population. This graph dramatically demonstrates the overuse of the atmosphere by industrial countries to dispose of their excess emissions. Indeed, SCO_2ER can be used to identify countries that are environmental creditors and debtors in relation to the atmosphere. On the basis of this criterion, all major industrial countries are CO_2 debtors and most developing countries are creditors living within the SCO_2ER .

Environmental debt can be seen as one of the principal ways in which wealthy countries attain their economic wealth. That is, wealthy countries depend upon the ability to release a substantial excess of CO_2 to the atmosphere (and extract natural resources virtually at will) without having to pay for such intensive use of the environment. Put in these terms, the CO_2 debt of each American is currently equal to the CO_2 credit created by 23 Indians, whose individual emissions of less than 0.8 tons per year are well within the biosphere's capacity to absorb. (See Figure 12)

A democratic principle of society-atmosphere relations underlies the SCO_2ER concept and the arguments depicted in Figures 10-12. This principle recognizes the atmosphere as a global commons on which all humanity, indeed, all living things, depends. If we are to respect our common dependence on a stable climate, specific actions will be needed to restore sustainability in society-atmosphere relations. In particular, those who have exceeded their fair share of the sustainable emission rate must be expected to bear the burden of action.

The Framework Convention on Climate Change (FCCC), signed in 1992 during the Earth Summit in Rio de Janeiro, Brazil, gave at least modest recognition of who should be obliged to take initial action. OECD countries are called upon under the Convention to take the first steps in ending the Experiment in Global Climate Change. Unfortunately, the burden on OECD countries prescribed in the FCCC is well less than what is needed. These countries are asked to freeze their emissions at 1990 levels by the year 2000 and, at this time, such "action" is voluntary. Nearly all OECD countries, including the U.S., have announced that they will not meet the Convention's year 2000 CO_2 guideline.

Once one understands what is actually needed to realize CO_2 sustainability, it is readily apparent why OECD countries are likely to resist the democratic approach considered here.

The Magnitude of the Problem

What would be the obligations of OECD countries if they were required to internalize the debt depicted in Figure 11? Internalization could be achieved by technological or environmental means. Each is explored is below.

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1 Thus, as world population increases, the Sustainable CO_2 Emission Rate necessarily falls. In addition, as deforestation and other sink-reducing activities increase, the SCO_2ER falls, *ceteris paribus*.

The Technological-Financial Option

Interestingly, if the U.S. and the rest of the OECD (industrial) countries were forced to stop appropriating more than their fair share of the CO_2 absorption capacity of the biosphere, and instead to rely alternative energy technologies and, thereby, end what is, in effect, biospheric and atmospheric imperialism, the cost, depending upon the technology to be used to avoid excess CO_2 emissions, would be about $1 trillion (if renewable energy technology is used at a cost of $145 per ton of avoided CO_2) to $2 trillion (if advanced CO_2 sequestration technology is used) per annum. In one scenario of technological internalization, OECD countries would be compelled to overhaul their energy systems and sequester CO_2 at the estimated cost of $1-2 trillion. Alternatively, such an expenditure (probably spread out over a 50-year period) would be paid via a carbon tax or emission permit system[2] in which OECD countries either pay or transfer to non-OECD countries technology that avoids CO_2 emissions. This second scenario can be compared to a "debt swap in which Third World economic debt is "paid" in CO_2 credit transfers. But the magnitude of the problem actually far exceeds that of Third World debt. In fact, Third World economic debt is approximately $700 billion (annualized, Third World debt is about $69 billion). In other words, it would take only about one-third to two-thirds of OECD monetized environmental debt to retire the entire economic debt of all developing countries.

The Environmental Option

Alternatively, OECD countries could pursue environmental strategies to absorb their excess CO_2 emissions. For example, if the U.S. and other wealthy societies were required to set aside and manage sufficient forest area to absorb their emissions, the challenge, to say the least, would be daunting. Using OECD/IEA's 1991 greenhouse emissions report to fix the area of bio-engineered forests needed to absorb the CO_2 emissions of the U.S., you arrive at the result shown in Figure 13.

The entire area designted for the U.S. National CO_2 Park as shown in Figure 13 would have to be covered with a fast-growing bio-engineered forest[3] and this forest area would have to be cut regularly, with the wood used as a non-combusted material or buried so that it could not release the stored CO_2. Human migration out of the area would, of course, be necessary in order to acquire a sufficient land surface for CO_2 absorption. Adding CO_2 sinks in Europe would involve much larger population dislocations.

Thus, in both technological and environmental terms, the OECD's overuse of the earth's CO_2 absorption capacity is mammoth in scale. Little wonder that OECD countries have been reluctant to address the problem and when they do, that such efforts seek to involve Southern countries in sharing the burden. The basic policy paradigms advocated by OECD countries are briefly reviewed below.

Conventional Thinking About Climate Change Policies

OECD countries have promoted, broadly speaking, three policies to address the problem of global climate change. These are the "no regrets," "insurance," and "pollutant market" approaches. While each of these approaches is distinguished by a particular combination of global rules and actions, they have several commonalities. One important shared characteristic is that all three have been developed from the ideological standpoint of industrial nations, primarily that of the U.S. In particular, these approaches were originally designed to address the issue of what the response of these nations should be to the issue of possible global climate change. Thus, there is a self-interested character in their formulation (although many scientists in OECD countries who urge action on the CO_2 problem believe that their advocacy crosses the traditional boundaries of politics and represents a global, rather than a national, interest).

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2 See below for a critique of the carbon tax and emission permit approaches.

3 Natural forests are simply too "slow" in their growth patterns to serve as CO_2 absorbers when the amount to absorb is on the scale of the U.S. excess.

The "No Regrets" Approach

Several economists who figure prominently in the global climate change policy debate use methods which are typical of the "no regrets" approach. They include Alex Cristofaro, Director of Air and Energy Policy at the U.S. Environmental Protection Agency, William Nordhaus, Professor of Economics at Yale university, and Thomas Shelling of the Kennedy School of Government at Harvard University.

The "no regrets" approach values economic growth and places great faith in the ability of technological advances to address humanity's major problems. This approach responds to global climate change by assessing the costs and benefits which industrial economies will incur in attempting to reduce GHG emissions below the warming threshold. These costs and benefits are then compared to the costs and benefits of doing nothing. If the net benefits of doing nothing exceed the net benefits of doing something, "no regrets" advocates recommend that no action be taken. Where uncertainties are present (and, of course, there will inherently be uncertainties involved in climate change research), this approach favors continued economic growth over CO_2 mitigation strategies that might slow growth.

This line of argument generally concludes that no action to eliminate the possibility of global climate change should be taken unless it is justified by other considerations. This is because potential costs of adverse environmental effects, when weighted by the uncertainty of whether and when such effects will occur, are usually found to be insignificant compared to the cost of prevention at least for industrial countries. For example, economists of the U.S. Department of Agriculture in a 1989 study concluded that the costs of decreased grain yields in industrial countries as a result of climate change would be less that one-tenth of one percent of their GDP. This is because losses in yields would be largely offset by higher world prices. Econometric models used by the U.S. Environmental Protection Agency indicate that global warming could actually *increase* agricultural income in the U.S., while technologies to protect coastal cities against sea level rises – if these should occur – would probably cost far less than curtailments of greenhouse gas emissions.

Expectably, models based on the "no regrets" approach, conclude that the conomic and physical well-being of industrial nations would depend far more on investments in technological development than on the percentage of carbon dioxide in the air. But what this approach fails to take into account, among other things, is the international structure of inequality that underlies the distribution of costs and benefits. Global increases in food prices may have little impact on the citizens of the U.S. and other industrial nations but could have devastating effects on the citizens of developing nations. Many may find it difficult or impossible to muster the resources necessary to protect themselves from a rise in sea level, especially as some of them, such as Bangladesh, face the possibility of inundation.

In sum, using an incrementalist logic, the "no regrets" approach is likely to charge wealthy industrial countries little or nothing for creating the threat of climate change, while shifting the burdens and costs to the currently industrializing countries.

The "Insurance" Approach

The main protagonists of this second approach are Alan Manne of Stanford University, Richard Richels of the U.S. Electric Policy Research Institute, and William Cline of the Institute for International Economics. The "insurance" proposal argues that a share of global wealth should be diverted from economic growth in order "purchase" some measure of insurance against catastrophe. In essence, climate change is treated like other uncontrollable natural events such as cyclones or earthquakes and advocates counsel actions that can minimize so-called "worst case" losses. This can be realized by such things as developing heat-resistant seeds for agriculture or reducing the rate of CO_2 emissions to the point where temperature rises are "manageable."

This approach is built on the assumption that we can actually manage and even finely tune global climate change. In particular, we are supposed to understand that it is possible to "allow" surface warming to

proceed to a point just short of the threshold point where catastrophe occurs. The worst-case scenario is then averted because we have taken the minimum steps necessary to reduce impacts to a sub-catastrophic level. Even if we ignore the hubris of this position, the problem of inequality remains. Thus, as sub-catastrophic warming take place, Southern countries will be least able to "collect" on the insurance policy, since the adverse effects of warming cannot be as readily adapted to by the poor. Again, the South will bear the major social burdens of the management strategy despite the fact that they had no measurable role in the century and longer buildup of greenhouse gases in the atmosphere.

The "Pollutant Market" Approach

The advocates of the "pollutant market" approach hold that market mechanisms are the most efficient way for achieving any reduction in greenhouse gas emissions. Once agreement has been reached on the permissible levels of such emissions, proponents of a "pollutant market" approach believe that a free market should be set up to assure that the overall objective is reached efficiently. This is generally contemplated as either the levying of a global carbon tax or the creation of an international emissions trading regime. A proponent of this argument is David Pearce of the UK.

A third scenario corresponds to what has been termed "joint implementation" (JI) plans in which CO_2 debtors pay CO_2 creditors to expand CO_2 sinks in the creditor country as a means of offsetting CO_2 emissions in the debtor country. Such an approach is already being investigated on a pilot basis in an agreement between Costa Rica and the U.S. The problem, however, with this approach is readily apparent: the land area required for reforestation is nearly continental – an area perhaps two-thirds the size of South America could be neededWhile all three – carbon taxes, tradeable emission permits and joint implementation – purport to be only instrumentalist tools without a normative agenda, in fact their subtexts involve an unmistakable set of ideological values and relations. Each instrumentalist strategy fails to place any intrinsic value on the natural environment. Instead, the value of nature is determined by the actors in the pollutant market, the "buyers" and "sellers" of pollution. The outcome of these approaches is not difficult to guess. The industrial nations of the world have considerably more market power and will have relatively greater ability to set the terms of emission abatement to their advantage.[4] As well, these market approaches assign no historical cost for use of the atmosphere as a CO_2 storage basin. Rather, only incremental costs are assigned, and these fall hardest on the most recent emitters – Southern countries. Finally, an important outcome of these approaches is that CO_2 sinks such as forests are devalued because their non-monetary ecological value must compete against their money value as lumber. Obviously, when monied interests decide the price, it is not difficult to figure out what will be the likely result.

In sum, all three approaches developed by OECD analysts assume that the atmosphere ought to be treated as a commodity with its value determined by the contending interests of industrial development and environmental protection. But such thinking, in any of its three forms, is feasible only if we can assume that: (a) the natural environment has an essentially limitless capacity to absorb greenhouse gases; (b) we are all equal in our access to this assumed limitless reservoir; and (c) we are all equally capable of dealing with the natural and social consequences of global warming.

But we know that all three assumptions are false. Inequality in economic terms has a nearly exact counterpart in environmental terms. Nations are not equal in their access to natural resources; nor are they equal in their capacity to cope with global warming. Finally, global warming is a prima facie case that the natural reservoir is not limitless.

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4 This can include negotiating tax rates, permit transfers and JI plans in the climate change arena with explicit or implied contingencies concerning development assistance.

An Equity-Based Approach

The ideological underpinnings of the current climate change debate can be brought into even sharper relief if we consider a scenario in which economic parity is directly required in our policy strategy. As a first-cut idea of what this might mean, my colleagues and I at the Center for Energy and Environmental Policy constructed a scenario in which economic parity and emission equality were set as goals for the year 2050 A.D. These scenarios are depicted in Figure 14 and Figure 15, respectively.

In this scenario analysis, emission equality is set as a policy goal for the year 2050, using the SCO_2ER of 3.3 tons per person per year described earlier. Countries are grouped into four income categories – low, lower-middle, upper-middle and high – and economic parity is defined as closing the income gap among the four categories. As a means of setting CO_2 emission targets for each income country group to the year 2050, a computer software program was written to interpolate between the given CO_2 emission values in 1990 and the SCO_2ER set for 2050. For developing countries where 1990 emissions per capita were less that the target (3.3 tons), curve fitting was applied to asymptotically increase to the target rate: and for countries above the target rate, curve-fitting was used to plot an asymptotic decrease in emissions until SCO_2ER is reached. The results are shown in Figure 14.

In this CO_2 equality scenario, developing countries would continue to experience rapid income growth, almost achieving economic parity with developed countries. Given the allowance of a CO_2 target of 3.3 tons in 2050, the low-income and lower-middle income countries, which emitted an average 1.2 and 2.9 tons of CO_2 per capita, respectively, would register annual income growth rates of 6.9% and 4.9%, respectively, reaching per capita GDP levels of around $25,000 by the year 2050. In contrast, the upper-middle income and high-income countries will show slower growth rates (3.1% and 0.5%, respectively), reaching the level of around $30,000 (see Figure 15) In this scenario, the average annual population growth rates for industrial and developing countries are 0.25% and 1.25%, respectively.

To achieve economic and environmental parity, a sizable increase in CO_2 emissions in the low-income countries is anticipated to take place, even assuming that energy conservation and renewable energy will play a major role in the development of these countries (the annual improvement of fossil fuel energy intensities of both low-income can lower-middle income countries must be 2.9% and 2.7%, respectively). For the upper-income countries to reduce emissions to the SCO_2ER, fossil energy use would need to be cut by about half, to be replaced by energy conservation and the development of renewable energy (fossil fuel energy intensities of both upper-middle income and high-income countries must be annually improved by 2.5% and 2.2.%, respectively). At the same time, high-income countries would have to work with others to rapidly develop and deploy renewable energy technologies that suit individual national needs, while also ensuring that a sustainable CO_2 emission rate can be achieved. It should be noted, however, that even by meeting CO_2 emission targets, the wealthy would continue to be massive environmental debtors until 2050.

Precisely because of the sizable burden that OECD countries would face under our equity-based proposal, it is clear that there would be strong resistance to its adoption. Yet, it should be equally clear that the sort of approach described here offers the only politically feasible way of redressing the basic injustice that pervades the present political economy of nature-society relations, namely, a return of the atmosphere to its rightful status as a commons beyond exploitive use by wealthy countries at the expense of social and environmental sustainability.

Conclusion

In closing, let me try to address a question many often ask. I am aware, for example, of the ongoing debate in India over the issue of climate change. It can be and has been argued that climate change is the creation of Western countries and they should handle it. Indeed, many may feel that the West is using the issue as a bogey to thwart development of countries like India. But while the crisis of climate change is not the

making of India or other Southern countries, the South needs to be concerned and to be involved to ensure that international policies on global warming do not adversely affect their economic and political interests still further.

As our emission equality scenario demonstrates, acting on the issues of global climate change need not mean sacrificing economic development in the South. But if India and other countries refuse to become involved, this will play into hands of the West which does not want to reduce its material consumption and would much prefer to use economic growth to shelter itself from the ill-effects of climate change. In such a situation, developing countries will be the first to suffer from climate change and will experience the bulk of its costs. Hence, Southern countries, and especially countries with large rapidly growing economies such as India, China, and Brazil, need to act in unison and demand that the West take appropriate actions to end the appropriation of our atmospheric commons. It would be an important first step in reclaiming a commons relation between humanity and the natural world, one that is essential to a genuinely sustainable, peaceful future for South and North together.

Figure 1
SO_2 Pollution in the World's 15 Megacities

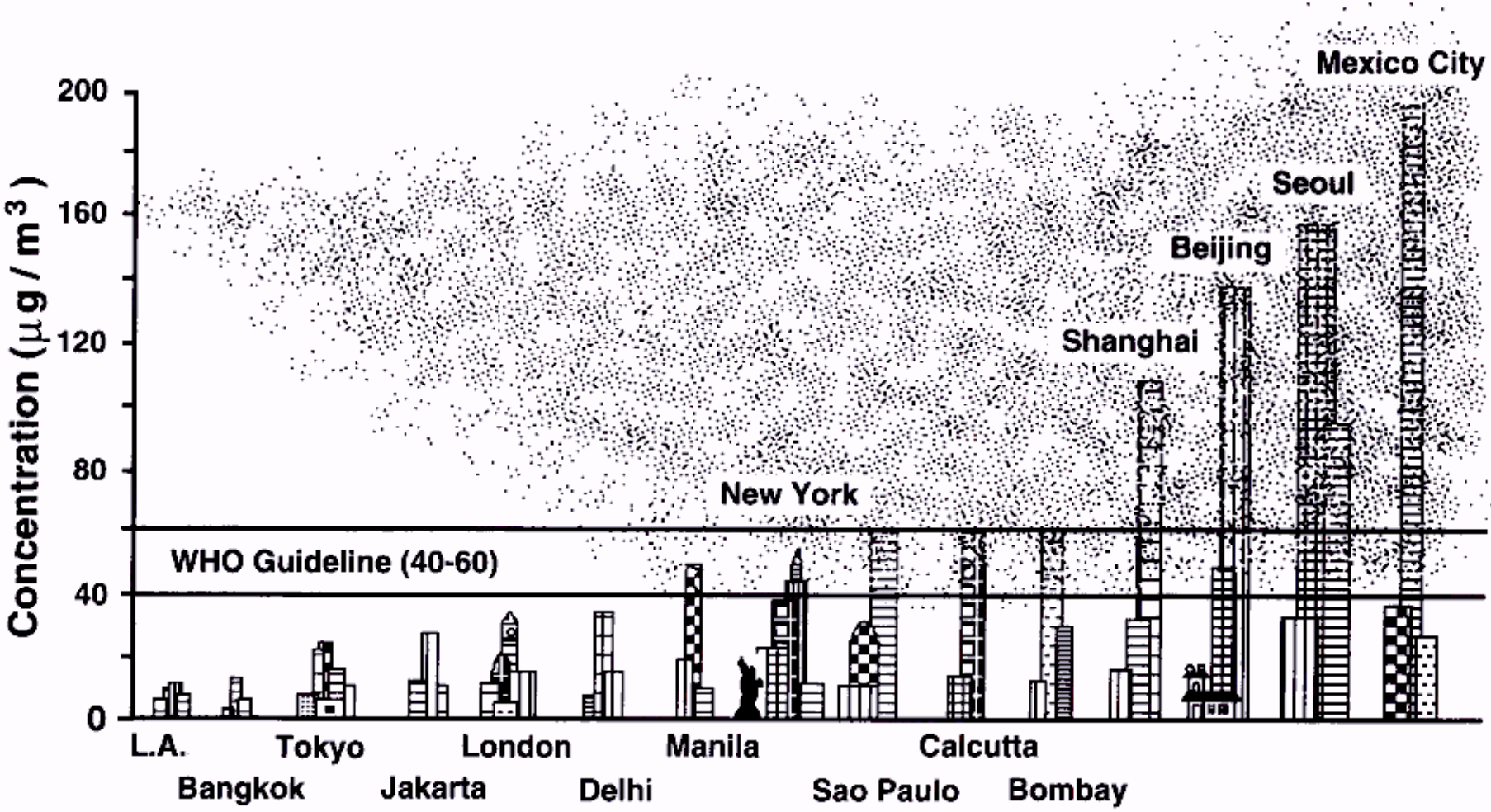


Figure 2
SPM Pollution in the World's 15 Megacities

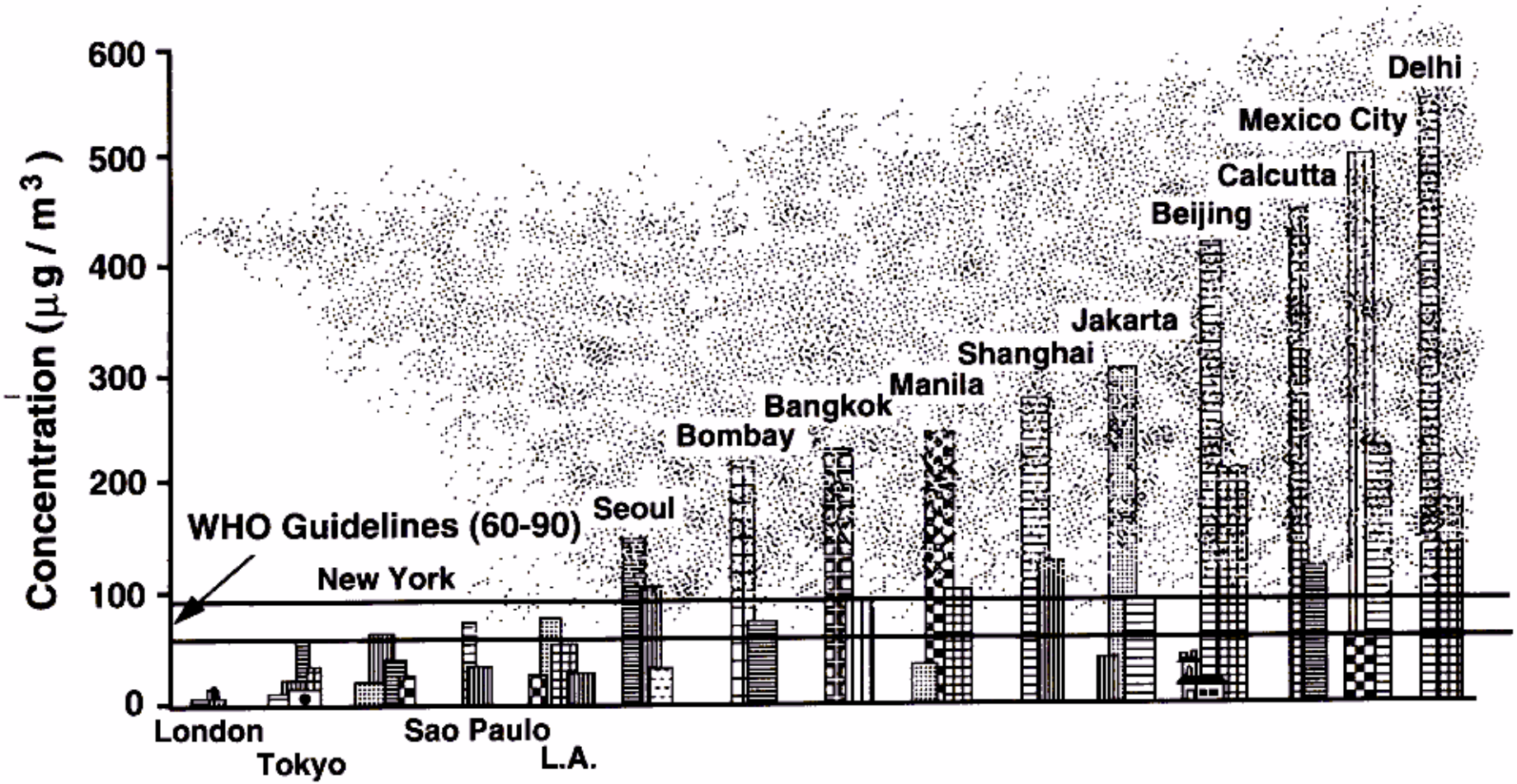


Table 1
Import - Export of Sulfur* Pollution in Selected European Countries

Country	Total Emissions	Total Deposition	Share of Emissions Exported[a]	Share of Deposition Imported
	(thousand tons)		(percent)	
Norway	37	210	76	96
Austria	62	181	74	91
Sweden	110	302	69	89
Switzerland	37	65	81	89
Netherlands	145	104	80	72
France	760	622	67	59
Czechoslovakia	1,400	659	75	47
Poland	2,090	1,248	68	46
CIS[b]	5,150	3,201	61	38
Germany	3,175	1,415	72	37
Italy	1,185	510	72	36
Spain	1,625	590	72	22
United Kingdom	1,890	636	71	15

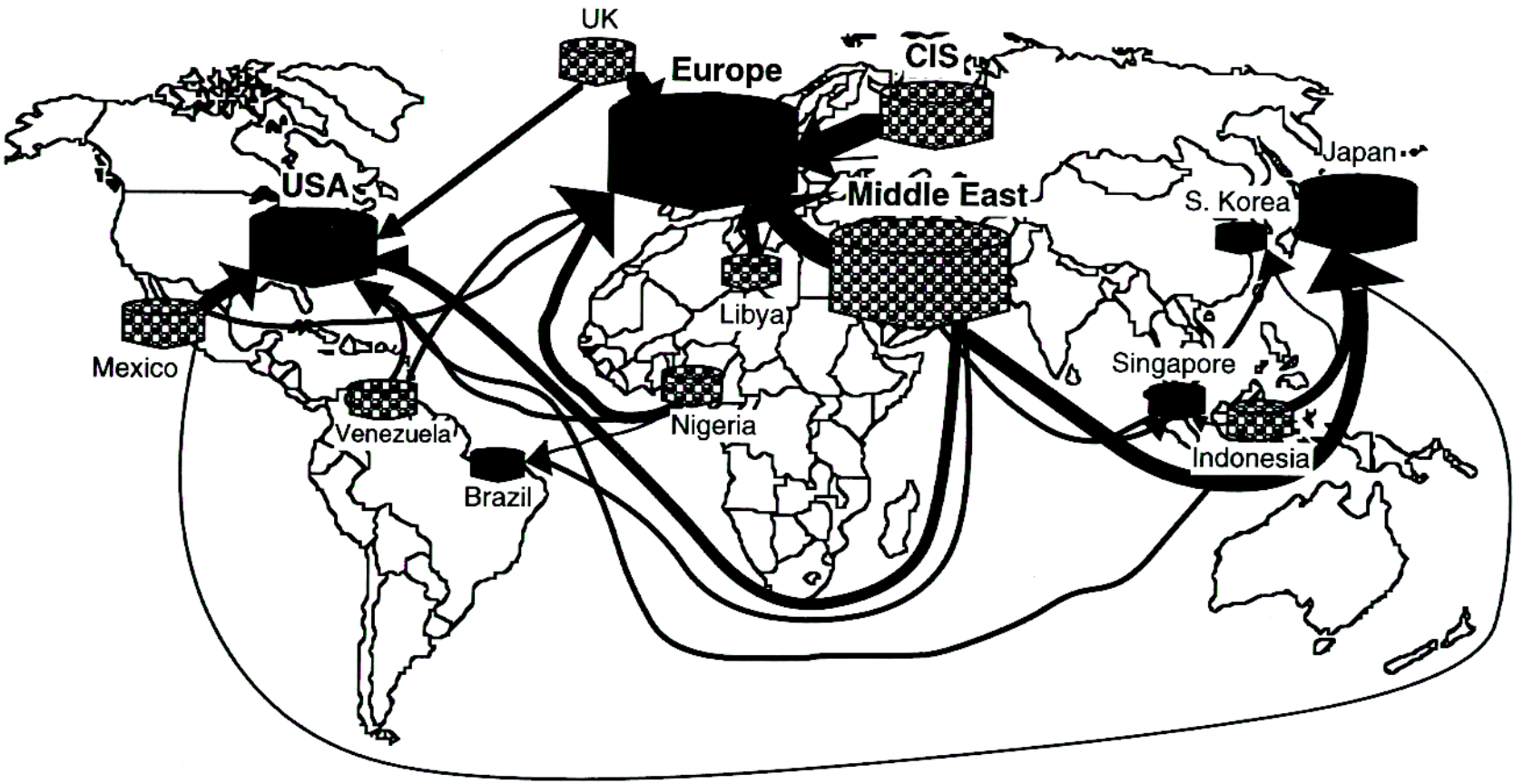
Notes: * Sulfur is generally emitted as sulfur dioxide but may fall to earth as a variety of its chemical derivatives, including suluric acid and sulfates.

[a] May be deposited either in another country or over a body of water.

[b] Only the European part of CIS; thus export figure includes exports to the Asian part of CIS.

Sources: Worldwatch Institute, based on emissions data in Economic Commission for Europe, "Annual Review of Strategies and Policies for Air Pollution Abatement" (draft); and transboundary flows data supplied by the European Monitoring and Evaluation Program.

Figure 3
International Movement of Oil



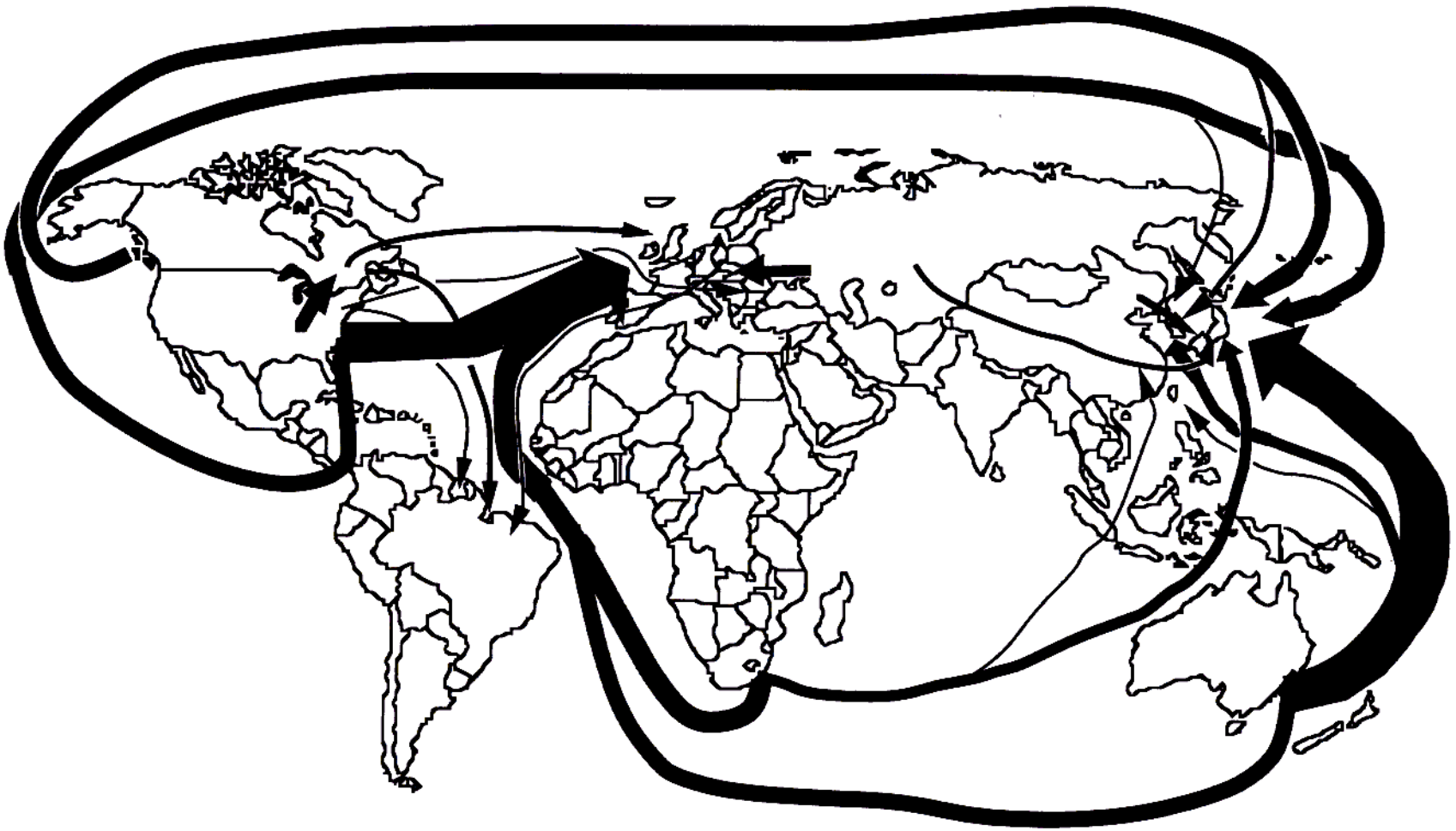
Major Exporters

Major Importers

Note: Containers are drawn in proportion to typical yearly volume of imports and exports from a particular country or region.

Source: UN, *Yearbook of World Energy Statistics*.

Figure 4
International Movement of Coal



Note: Flows are drawn in proportion to typical yearly shipments into or out of a particular country or region.

Source: UN, *Yearbook of World Energy Statistics*.

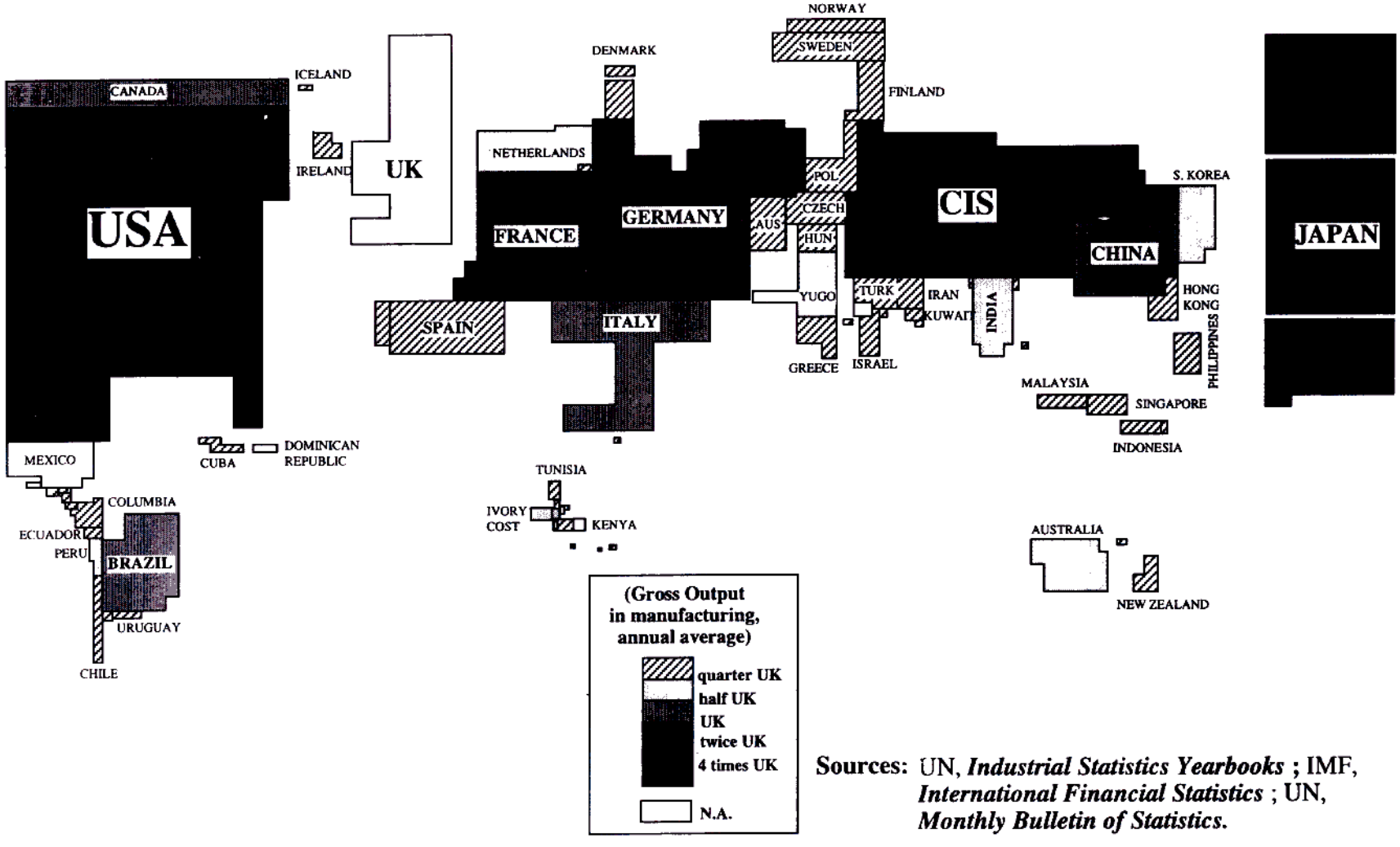
Table 2
Health Effects of Pollutants

Pollutants	Health Effects
Carbon Monoxide	Interferes with blood's ability to absorb oxygen, which impairs perception and thinking, slows reflexes, causes drowsiness, and can cause unconsciousness and death; if inhaled by pregnant women, may threathen growth and mental development of fetus..
Lead	Affects circulatory, reproductive, nervous, and kidney system; suspected of causing hyperactivity and lowered learning ability in children; accumulates in bone and other tissues, so hazardous even after exposure ends.
Nitrogen Dioxide	Can increase susceptibility to viral infections such as influenza, irritate the lungs, and cause bronchitis and peumonia.
Ozone	Irritates mucous membranes of respiratory system; causes coughing, choking, impaired lung function; reduces resistance to colds and pneumonia; can aggravate chronic heart disease, asthma, bronchitis, and emphysema.
Toxic Emissions	A broad category including many different compounds that are suspected or known to cause cancer, reproductive problems, and birth defects.

Sources: Worldwatch Institute, based on National Clean Air Act Coalition, ***The Clean Air Act: A Briefing for Members of Congress***; and other sources.

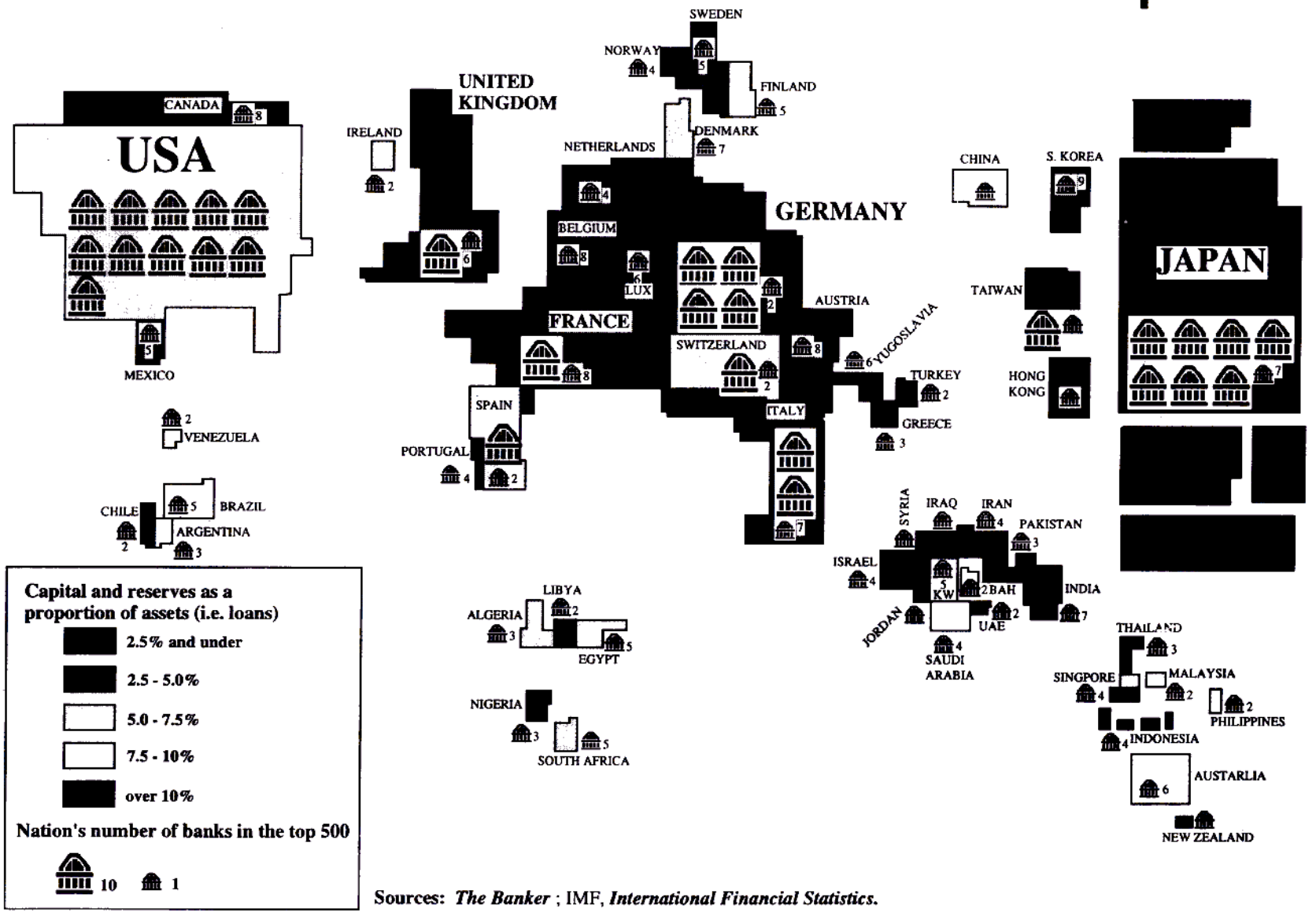
Figure 5

International Distribution of Industrial Power: Value of Gross Manufacturing Output



Sources: UN, ***Industrial Statistics Yearbooks*** ; IMF, ***International Financial Statistics*** ; UN, ***Monthly Bulletin of Statistics.***

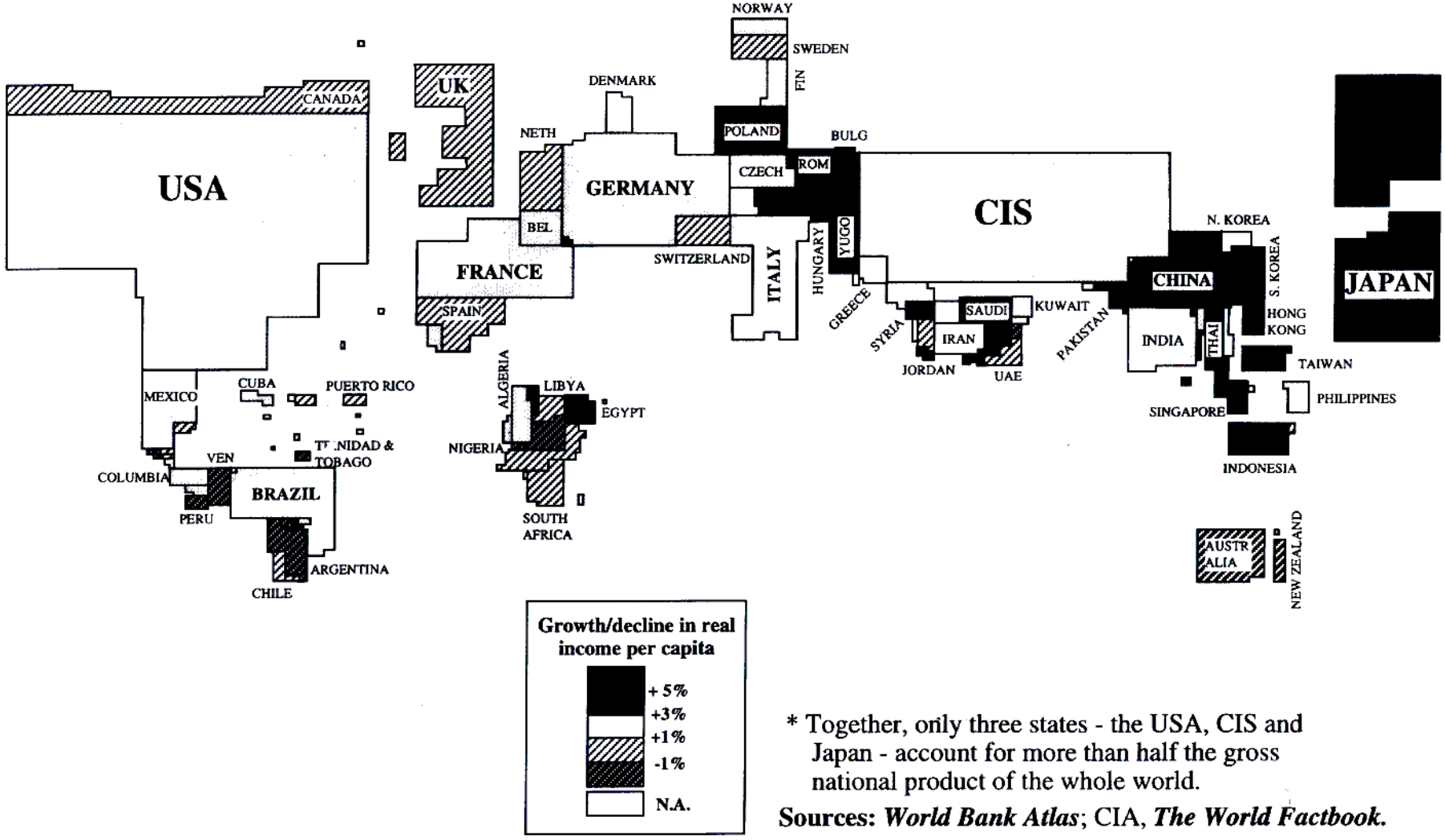
Figure 6
International Distribution of Commercial Capital



Sources: ***The Banker*** ; IMF, ***International Financial Statistics.***

Figure 7

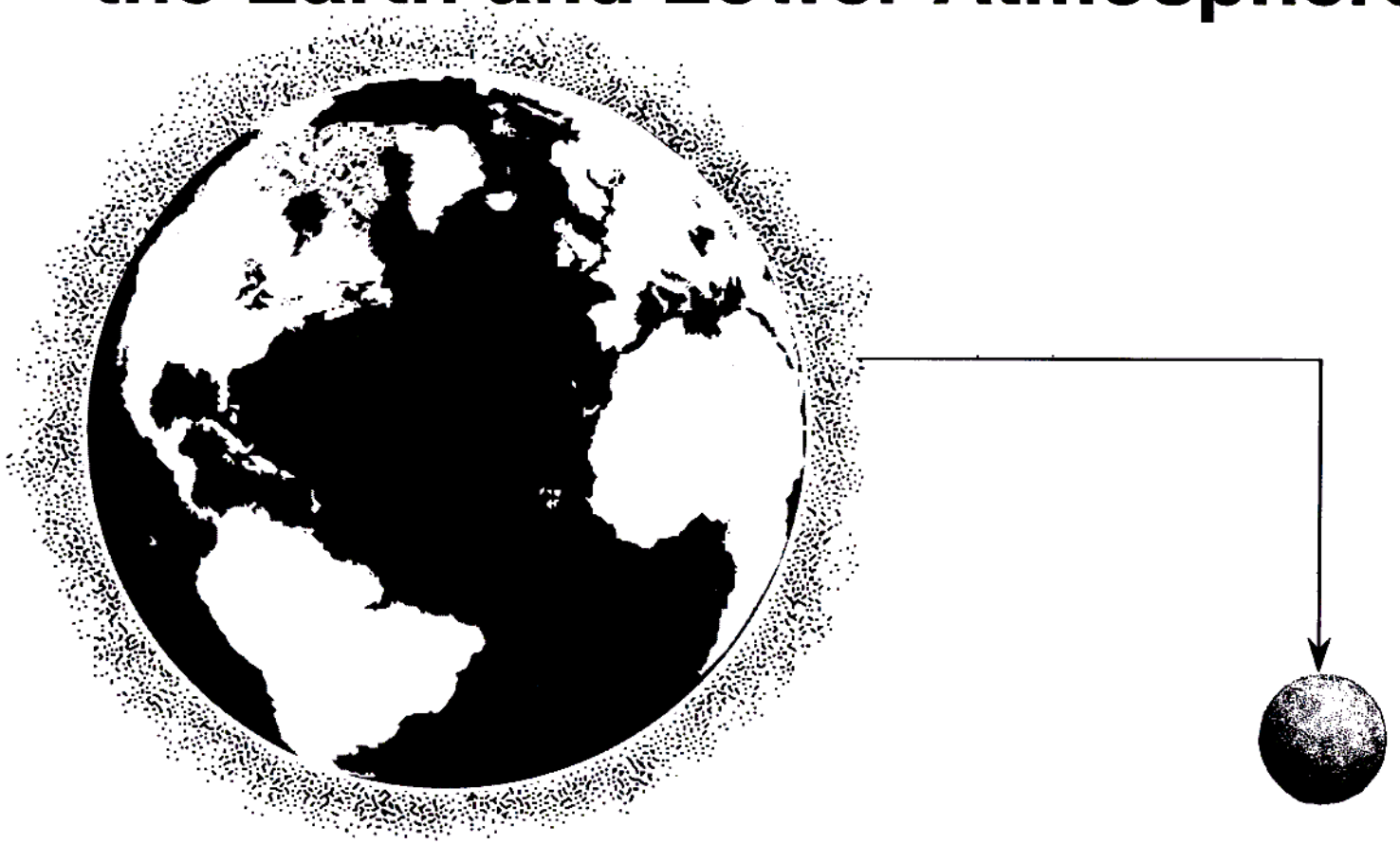
International Distribution of Purchasing Power: National Shares of Total World GNP



* Together, only three states - the USA, CIS and Japan - account for more than half the gross national product of the whole world.

Sources: ***World Bank Atlas***; CIA, ***The World Factbook.***

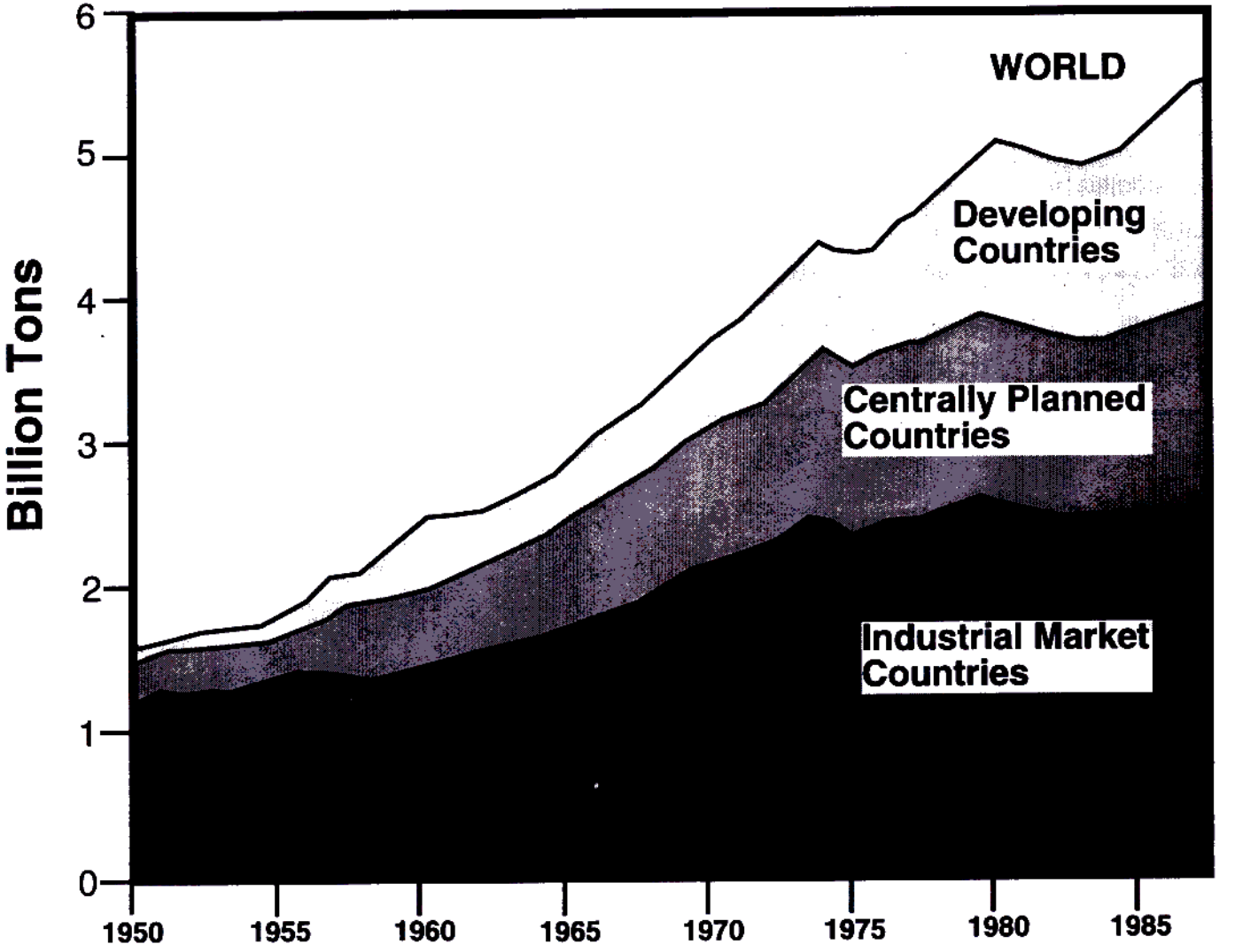
Figure 8
Volume of the Earth and Lower Atmosphere



Volumetric Ratio: about 250 to 1

Figure 9

Carbon Emissions from Fossil Fuels



Sources: Oak Ridge National Laboratory; Worldwatch Institute.

Table 3
Characteristics of
Greenhouse Gases Affected by Human Activities

	CO_2	CH_4	N_2O	CFC-11	HCFC-22 (a CFC substitute)	CF_4 (a perfluoro-carbon)
Pre-industrial concentration	~280 ppmv	~700ppbv	~275 ppbv	zero	zero	zero
Concentration in 1994	358 ppmv	1720 ppbv	312[a] ppbv	268[a] pptv[b]	110 pptv	72[a] pptv
Rate of concentration change*	1.5 ppmv/yr	10 ppbv/yr	0.8 ppbv/yr	0 pptv/yr	5 pptv/yr	1.2 pptv/yr
	0.4%/yr	0.6%/yr	0.25%/yr	0%/yr	5%/yr	2%/yr
Atmospheric lifetime (years)	50-200[c]	12[d]	120	50	12	50,000

Notes: [a] Estimated from 1992-1993 data.

[b] 1 pptv = 1 part per trillion (million million) by volume.

[c] No single lifetime for CO_2 can be defined because of the different rates of uptake by different sink processes.

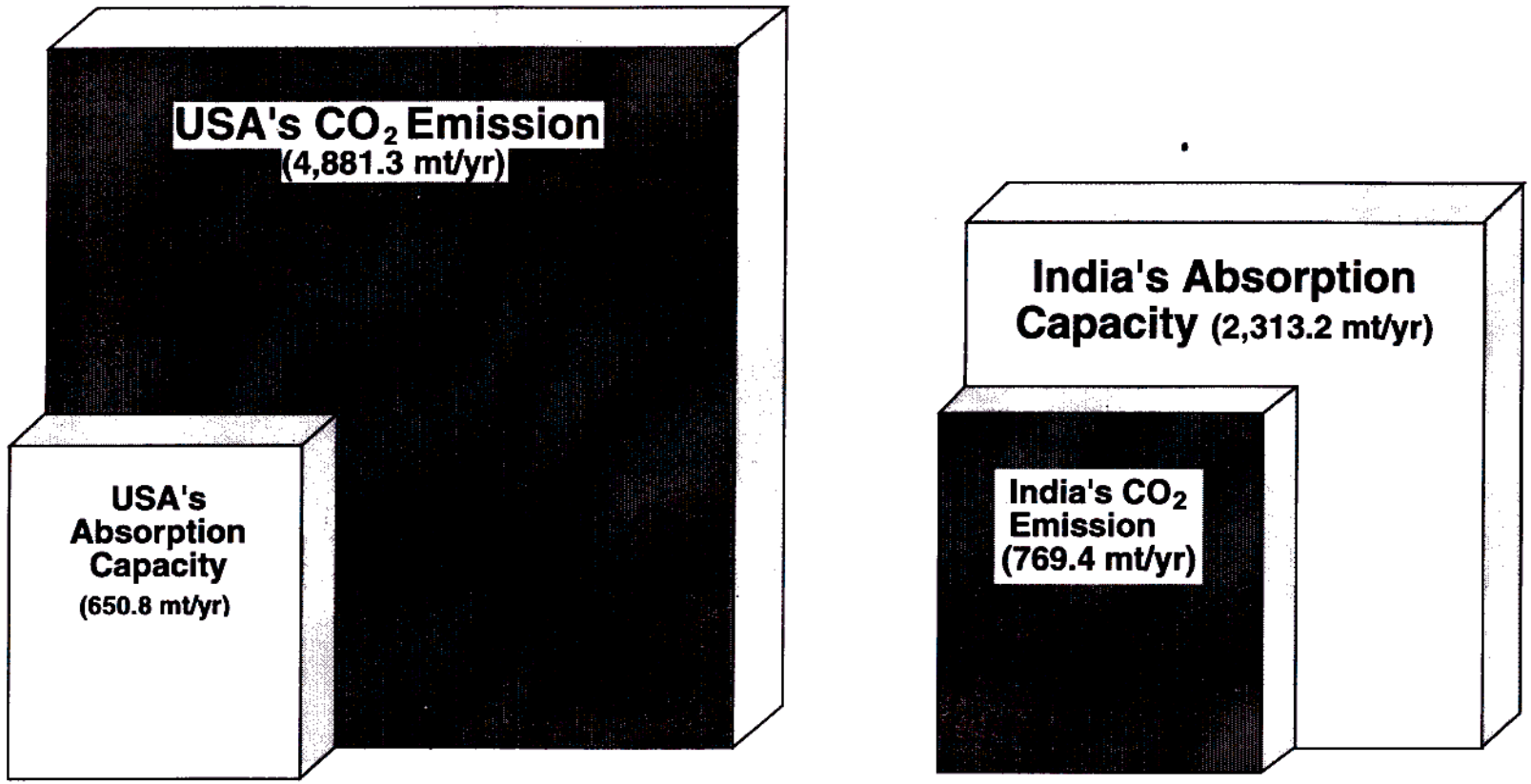
[d] This has been defined as an adjustment time which takes into account the indirect effect of methane on its own lifetime.

* The growth rates of CO_2, CH_4 and N_2O are averaged over the decade beginning in 1984; halocarbon growth rates are based on recent years.

Source: J. T. Houghton et al. *Climate Change 1995: The Science of Climate Change.*

Figure 10

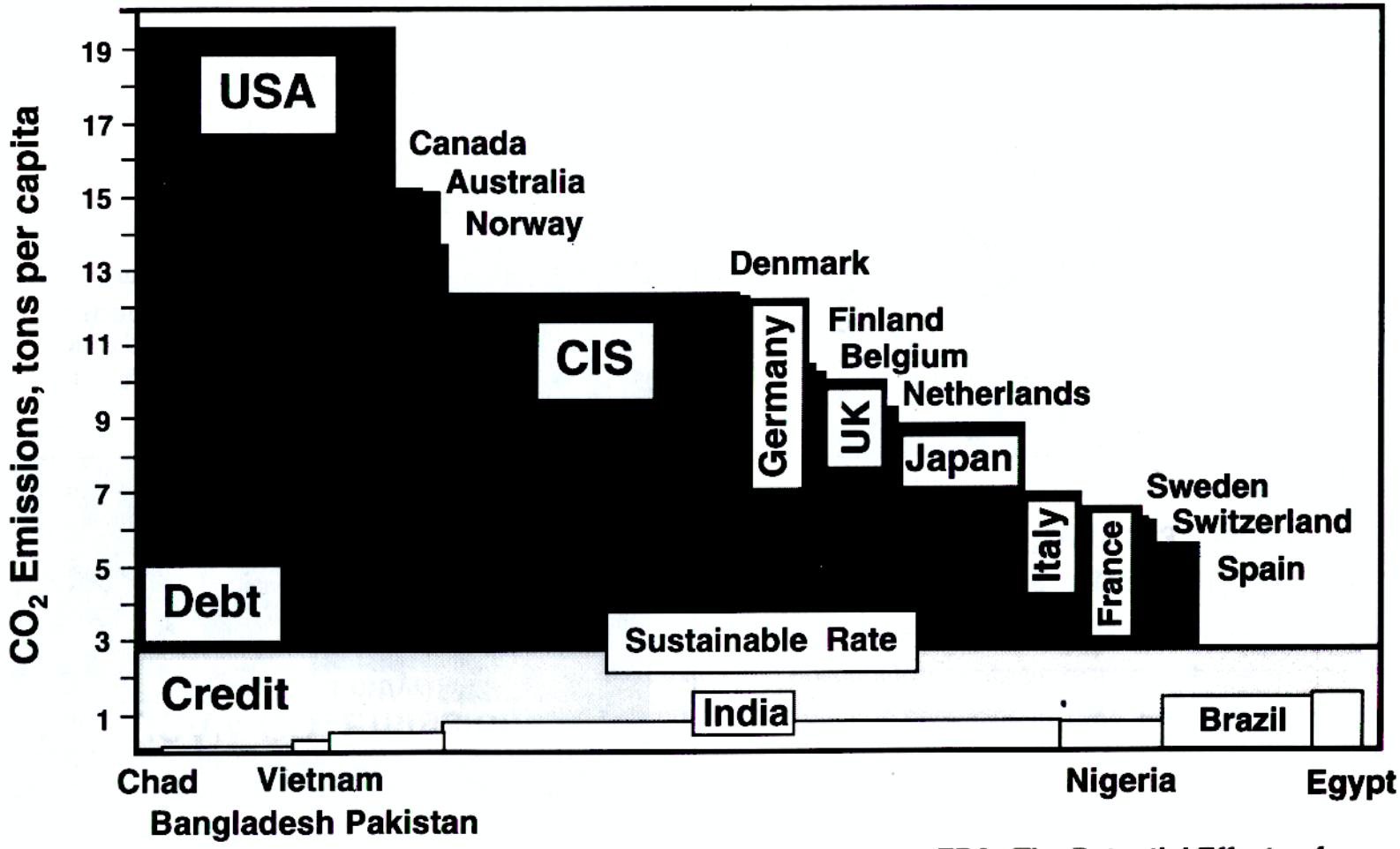
CO_2 Emissions vs. Democratic Share of Biospheric Absorption Capacity:* USA and India



* Democratic Share of Biospheric Capacity = Total Biospheric Absorption Capacity of CO_2 × USA's (India's) Share of World Population

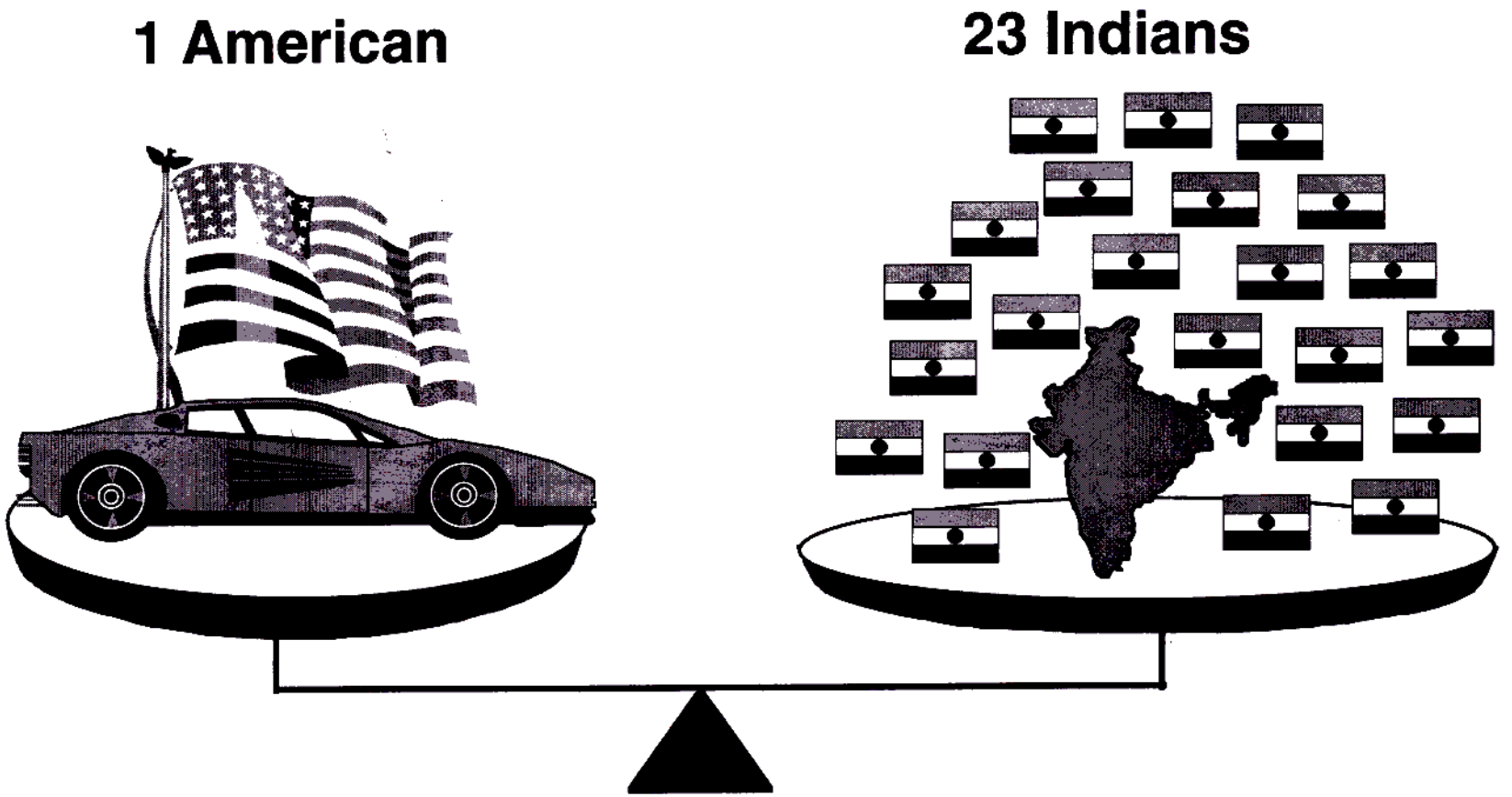
Sources: EIA, *State Energy Data Reports*; EPA, *The Potential Effects of Global Climate Change on the United States*; Center for Energy and Environmental Policy, University of Delaware.

Figure 11
CO_2 Emissions per Capita



Sources: World Resources Institute, *World Resources*; EPA, *The Potential Effects of Global Climate Change on the United States.*

Figure 12
Inequality of Atmosphere Use



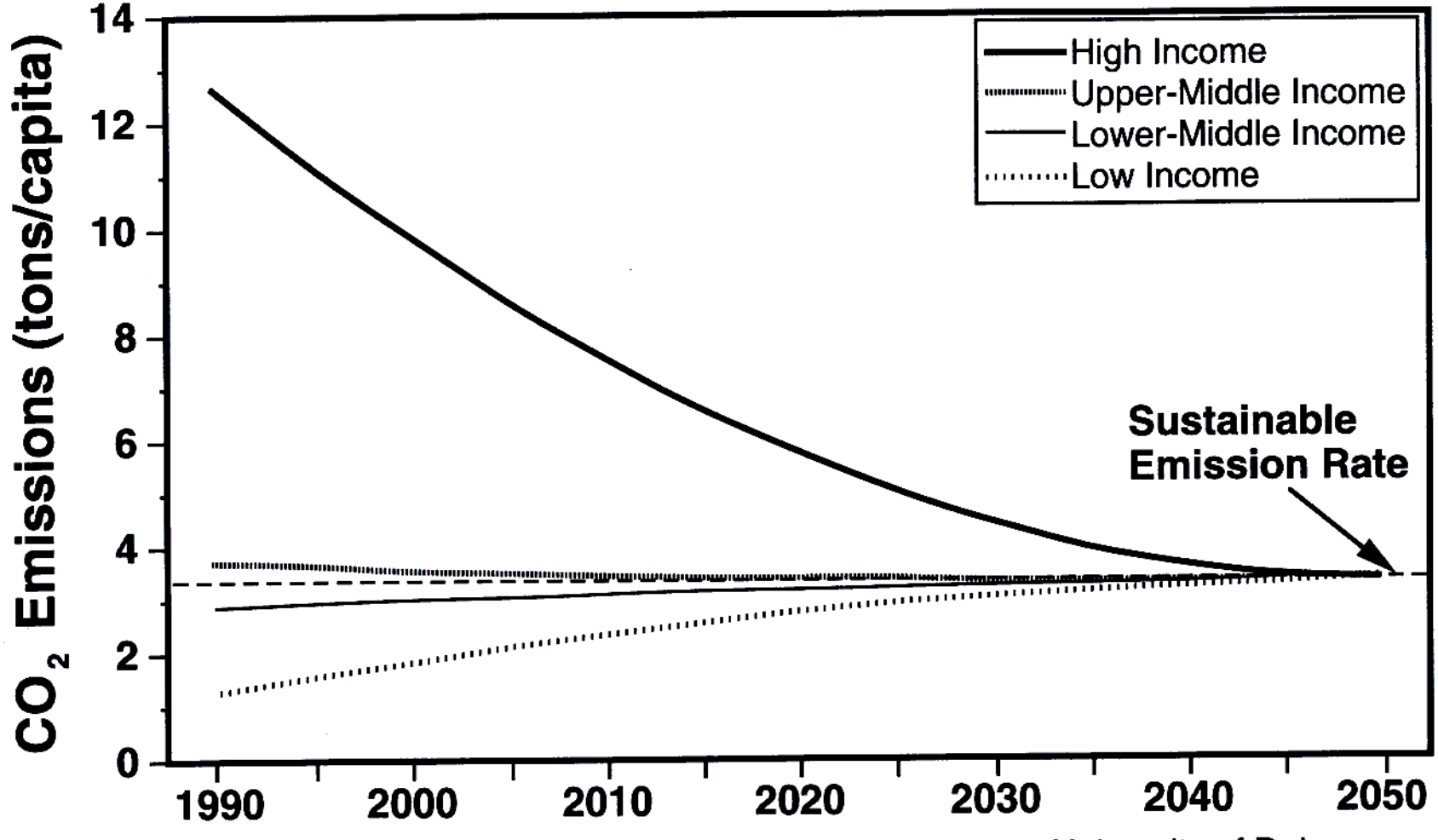
Source: World Resources Institute, *World Resources*.

Figure 13
National CO_2 Park

*** Displaced population: 23.6 million**

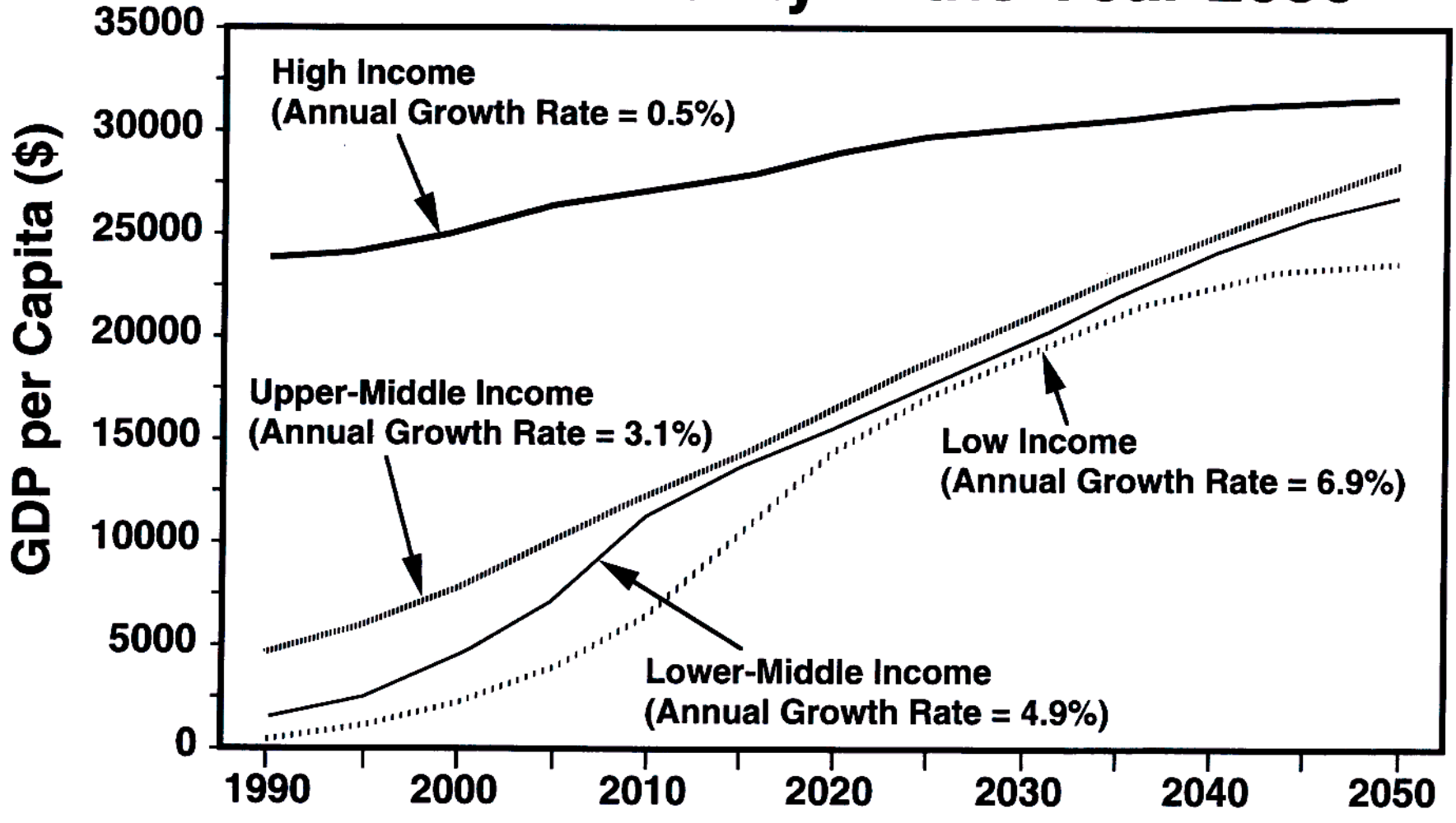
Sources: World Resources Institute, *World Resources*; US Bureau of the Census, *Statistical Abstract*; OECD/IEA, *Greenhouse Gas Emissions*; Center for Energy and Environmental Policy, University of Delaware.

Figure 14
CO_2 Parity in the Year 2050



Source: Center for Energy and Environmental Policy, University of Delaware

Figure 15
Economic Parity in the Year 2050



Source: Center for Energy and Environmental Policy, University of Delaware