Chapter 1: THE CASE THAT THE WORLD HAS REACHED LIMITS:
-- More precisely that current throughput growth in the global economy cannot be sustained --

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Mahatma Gandhi [when asked if, after independence, India would attain British standards of living] "... it took Britain half the resources of the planet to achieve its prosperity; how many planets will a country like India require ...?"

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1. Introduction

The aim of this chapter is to present the case that limits to growth have already been reached, that further input growth will take the planet further away from sustainability, and that we are rapidly foreclosing options for the future, possibly by overshooting limits (Catton 1982). This chapter seeks to convince the reader of the urgent need to convert to a sustainable economy, rather than the related and equally or more important need of poverty alleviation. The political will to transit to sustainability will be mustered only when the need for the transition is perceived. The crucial next step -- how to muster that political will -- is deferred to a subsequent book.

Right at the start, plaudits for Brundtland’s heroic achievement: elevating "sustainability" as a planetary goal now espoused by practically all nations, the UN family, and the World Bank. In July 1989, leaders of the Group of Seven major industrialized nations called for "the early adoption, worldwide, of policies based on sustainable development." The whole world owes Brundtland an enormous debt for this tremendous feat and we admire her political wisdom. This chapter builds on Brundtland’s lead and explores the implications of sustainability. We assume as given that the world is being run unsustainably now -- being fuelled by inherited fossil fuels is the best single example. Nonrenewable oil and gas provide 60% of global energy with barely 50 years of proven reserves.

Brundtland said that meeting essential needs requires "a new era of economic growth" for nations in which the majority are poor. The report (WCED, 1987) anticipates "... a five- to tenfold increase in world industrial output..." Two years later, this "sustainable growth" conclusion was re-emphasized by the Secretary General of the Brundtland Commission: "A fivefold to tenfold increase in economic activity would be required over the next 50 years..." to achieve sustainability (MacNeill, 1989).

2. The Global Ecosystem and the Economic Subsystem

A single measure -- population times per capita resource consumption -- encapsulates what is needed to achieve sustainability. This is the scale of the human economic subsystem with respect to that of the global ecosystem on which it depends, and of which it is a part. The global ecosystem is the source of all material inputs feeding the economic subsystem, and is the sink for all its wastes. Population times per capita resource consumption is the total flow -- throughput -- of resources from the ecosystem to the economic subsystem, then back to the ecosystem as waste, as dramatized in
Figure 1. The upper diagram illustrates the bygone era when the economic subsystem was small relative to the size of the global ecosystem. The lower diagram depicts a situation much nearer to today in which the economic subsystem is very large relative to the global ecosystem. Population times per capita resource use is refined by Tinbergen and Hueting (1991), and by Ehrlich and Ehrlich (1990).

The global ecosystem's source and sink functions have limited capacity to support the economic subsystem. The imperative, therefore, is to maintain the size of the global economy to within the capacity of the ecosystem to sustain it. Speth (1989) calculates that it took all of human history to grow to the $60-billion scale economy of 1900. Today, the world economy grows by this amount every two years. Unchecked, today's $20 trillion global economy may be five times bigger only one generation or so hence.

It seems unlikely that the world can sustain a doubling of the economy, let alone Brundtland's "five- to ten-fold increase". We feel throughput growth is not the way to reach sustainability; we cannot "grow" our way into sustainability. The global ecosystem, which is the source of all the resources needed for the economic subsystem, is finite and has limited regenerative and assimilative capacities. It looks inevitable that the next century will be occupied by double the number of people in the human economy consuming sources and burdening sinks with their wastes.

The global ecosystem is the sink for all the wastes created by the economic subsystem, and this sink has limited assimilative capacity. When the economic subsystem was small relative to the global ecosystem (Figure 1; upper), then the sources and sinks were large and limits were irrelevant. Leading thinkers, such as Ehrlich and Ehrlich (1990), Hardin (1991), Boulding (1991), Daly (1989, 1990, 1991), as well as the Club of Rome (Meadows et al. 1974), have shown for years that the world is no longer "empty"; the economic subsystem is large relative to the biosphere, and the capacities of the biosphere's sources and sinks are being stressed (Figure 1, lower diagram).

3. **Localized Limits to Global Limits**

This chapter presents the case that the economic subsystem has reached or exceeded important source and sink limits. We take as agreed that we have already fouled our nest: practically nowhere in this earth are signs of the human economy absent. From the center of Antarctica to Mount Everest human wastes are obvious and increasing. It is not possible to find a sample of ocean water with no sign of the 20 billion tons of human wastes added annually. PCBs and other persistent toxic chemicals like DDT and heavy metal compounds, have already accumulated throughout the marine ecosystem. One fifth of the world's population breathes air more poisonous than WHO standards recommend, and an entire generation of Mexico City children may be intellectually stunted by lead poisoning (Brown et al. 1991).

Since the Club of Rome's 1972 "Limits to Growth", the constraints have shifted from source limits to sink limits. Source limits are more open to substitution and are more localized. Since then, the case has substantially strengthened for limits to throughput growth. There is a wide variety of limits. Some are tractable and are being tackled, such as the CFC phase out under the Montreal Convention. Other limits are less tractable, such as the massive human appropriation of biomass (see below). The key limit is the sink constraint of fossil energy use. Therefore, the rate of transition to renewables including solar energy, parallels the rate of the transition to sustainability. Here the optimists add the possibility of cheap fusion energy by the year 2050. We are agnostic on
technology, and want to encourage it by energy taxes (Daly, this volume). Hitherto, technology has
only started to focus on input reduction and even less on sink management, which suggests there is
scope for improvements.

Land fill sites are becoming harder to find; garbage is shipped thousands of miles from
industrial to developing countries in search of unfilled sinks. It has so far proved impossible for the
US Nuclear Regulatory Commission to find anywhere to rent a nuclear waste site for US$100 million
pa. Germany’s Kraft-Werk Union signed an agreement with China in July 1987 to bury nuclear waste
in Mongolia’s Gobi desert. These facts prove that landfill sites and toxic dumps -- aspects of sinks --
are increasingly hard to find, that limits are near.

4. First Evidence: Human Biomass Appropriation

The best evidence that there are other imminent limits is the calculation by Vitousek et al.
(1986) that the human economy uses -- directly or indirectly -- about 40% of the net primary product
of terrestrial photosynthesis today. (This figure drops to 25% if the oceans and other aquatic
ecosystems are included). And desertification, urban encroachment onto agricultural land,
blacktopping, soil erosion and pollution are increasing -- as is the populations search for food. This
means that in only a single doubling of the world’s population (say 35 years) we will use 80%, and
100% shortly thereafter. As Daly (1991a,b) points out 100% appropriation is ecologically impossible
and socially highly undesirable. The world will go from half empty to full in one doubling period,
irrespective of the sink being filled or the source being consumed. Readers refusing to recognize
overfullness that has appropriated 40% for humans already should decide when between now and
100% they would be willing to say "enough". They should state in advance what evidence they will
require to be convinced. Although this evidence has not been refuted over the last five years, this
single study is so stark that we urge prompt corroboration and analysis of the implications.

5. Second Evidence of Limits: Global Warming

The evidence of atmospheric carbon dioxide accumulation are pervasive, as geographically
extensive as possible, and unimaginably expensive to cure if allowed to worsen. In addition, they are
unambiguously negative and strongly so. There may be a few exceptions, such as plants growing
faster in CO2-enriched laboratories where water and nutrients are not limiting. However in the real
world, it seems more likely that crop belts will not shift with changing climate, nor will they grow
faster because some other factor (eg: suitable soils, water) will become limiting. The prodigious
North American breadbasket’s climate may indeed shift north, but this does not mean the breadbasket
will follow because the rich prairie soils will stay put, and Canadian boreal soils and muskeg are very
infertile.

The second evidence that limits have been exceeded is global warming. 1990 was the warmest
year in more than a century of record keeping. Seven of the hottest years on record all occurred
in the last 11 years. The 1980s were 1°F warmer than the 1880s; while 1990 was 1.25°F warmer.
This contrasts alarmingly with the pre-industrial constancy in which the earth’s temperature did not
vary more than 2-4°F in the last ten thousand years. Humanity’s entire social and cultural
infrastructure over the last 7000 years has evolved entirely within a global climate that never deviated
as much as 2°F from today’s climate (Arrhenius and Waltz 1990).
Figure 1: The Finite Global Ecosystem Relative to the Growing Economic Subsystem

[after Daly 1990b; Goodland and Daly 1990]
It is too soon to be absolutely certain that global "Greenhouse" warming has begun: normal climatic variability is too great for absolute certainty. There is even greater uncertainty about the possible effects. But all the evidence suggests that global warming may well have started, that CO2 accumulation started years ago, as postulated by Svante Arrhenius in 1896, and that it is worsening fast. Scientists now practically universally agree that such warming will occur, although differences remain on the rates. The US National Academy of Science warned President Bush that global warming may well be the most pressing international issue of the next century. A dwindling minority of scientists remain agnostic. The dispute concerns policy responses much more than the predictions.

The scale of today's fossil-fuel-based human economy seems to be the dominant cause of greenhouse gas accumulation. The biggest contribution to greenhouse warming, carbon dioxide released from burning coal, oil and natural gas, is accumulating fast in the atmosphere. Today's 5.3 billion people annually burn the equivalent of more than one ton of coal each.

Next in importance contributing to Greenhouse warming are all other pollutants released by the economy that exceed the biosphere's absorptive capacity: methane, CFCs and nitrous oxide. Relative to carbon dioxide these three pollutants are orders of magnitude more damaging, although their amount is much less. Today's price to polluters for using atmospheric sink capacity for carbon dioxide disposal is zero, although the real opportunity cost may turn out to be astronomical.

The costs of rejecting the greenhouse hypothesis, if true, are vastly greater than the costs of accepting the hypothesis, if it proves to be false. By the time the evidence is irrefutable, it is sure to be too late to avert unacceptable costs, such as the influx of millions of refugees from low-lying coastal areas (55% of the world's population lives on coasts or estuaries), damage to ports and coastal cities, increase in storm intensity, and worst of all, damage to agriculture. And best of all, abating global warming may save money, not cost it, according to Lovins (1990) when the benefit from lower fuel bills is factored in. The greenhouse threat is more than sufficient to justify action now, even if only in an insurance sense. The question now to be resolved is how much insurance to buy?

Admittedly, great uncertainty prevails. But uncertainty cuts both ways. "Business as usual" or "wait and see" are thus imprudent, if not foolhardy. Underestimation of greenhouse or ozone shield risks is just as likely as overestimation. Recent studies suggest we are underestimating risks, rather than the converse. In May 1991, US EPA upped by 20-fold their estimate of UV-cancer deaths; and the earth's ability to absorb methane was estimated downwards by 25% in June 1991. In the face of uncertainty about global environmental health, prudence should be paramount.

The relevant component here is the tight relationship between carbon released and the scale of the economy. Global carbon emissions have increased annually since the industrial revolution; now at nearly 4% pa. To the extent energy use parallels economic activity, carbon emissions are an index of the scale of the economy. Fossil fuels account for 78% of US energy. Of course there is tremendous scope for reducing the energy intensity of industry and of the economy in general, that is why reductions in carbon emissions are possible without reducing standards of living. A significant degree of decoupling economic growth from energy throughput appears substantially achievable. Witness the 81% increase in Japan's output since 1973 using the same amount of energy. Similarly, the United States's near 39% increase in US GNP since 1973, but with only modest increase in energy use. This means energy efficiency increased almost 26%. Sweden -- cold, gloomy, industrialized and very energy efficient -- is the best example of how profitable it is to reduce CO2.
The Swedish State Power Board found that doubled electric efficiency, 34% decrease in CO2, phase out of the nuclear power which supplies 50% of the country's electricity, actually lowers consumers electricity bills by US$1 bn per year (Lovins, 1990). Other, less efficient nations should be able to do even better.

Reducing energy intensity is possible in all industrial economies and in the larger developing economies, such as China, Brazil and India. The scope of increasing energy use without increasing CO2 means primarily the overdue transition to renewables: biomass, solar, hydro. The other major source of carbon emissions -- deforestation -- also parallels the scale of the economy. More people needing more land push back the frontier. But there are vanishingly few geopolitical frontiers left today.

Greenhouse warming is a compelling argument that limits have been exceeded because it is globally pervasive, rather than disrupting the atmosphere in the region where the CO2 was produced. In comparison, acid rain damaging parts of the United States and Canada, and those parts of Scandinavia downwind from UK, and the "Waldesterben" or US$30 billion loss of much of Europe's forest are more regional evidence for limits.

The nearly 7 billion tons of carbon released to the atmosphere each year by human activity (from fossil fuels and deforestation) accumulate in the atmosphere, which suggests that the ecosystem's sinks capable of absorbing carbon have been exceeded, and carbon accumulation appears for all practical purposes irreversible on any relevant time frame, hence it is of major concern for sustainability for future generations. Removal of carbon dioxide by liquefying it or chemically scrubbing it from the stacks might double the cost of electricity. Optimistically, technology may reduce this cost, but still at a major penalty.

6. Third Evidence: Ozone Shield Rupture

The third evidence that global limits have been reached is the rupture of the ozone shield. It is difficult to imagine more compelling evidence that human activity has already damaged our life support systems than the cosmic holes in the ozone shield. That CFCs would damage the ozone layer was predicted as far back as 1974 by Sherwood Rowland and Mario Molina. But when the damage was first detected -- in 1985 in Antarctica -- disbelief was so great that the data were rejected as coming from faulty sensors. Retesting and a search of hitherto undigested computer printouts confirmed that not only did the hole exist in 1985, but that it had appeared each spring since 1979. The world had failed to detect a vast hole that threatened human life and food production and that was more extensive than the United States and taller than Mount Everest (Shea 1989). All subsequent tests have proved global ozone layer thinning far faster than models predicted.

The relationship between the increased ultraviolet "b" radiation let through the impaired ozone shield and skin cancers and cataracts is relatively well known -- every 1% decrease in the ozone layer results in 5% more of certain skin cancers -- and alarming in neighboring regions (eg: Queensland). The world seems set for 1 billion additional skin cancers, many of them fatal, among people alive today. The possibly more serious human health effect is depression of our immune systems, increasing our vulnerability to an array of tumors, parasites and infectious diseases. In addition, as the shield weakens, crop yields and marine fisheries decline. But the gravest effect may be the uncertainty, such as upsetting normal balances in natural vegetation. Keystone species -- those on which many others depend for survival -- may decrease leading to widespread disruption in
environmental services and accelerating extinctions.

The one million or so tons of CFCs annually dumped into the biosphere take about 10 years to waft up to the ozone layer, where they destroy it with a half life of 100 to 150 years. The tonnage of CFCs and other ozone-depleting gases released into the atmosphere is increasing damage to the ozone shield. Today's damage, although serious, only reflects the relatively low levels of CFCs released in the early 1980s. If CFC emissions cease today, the world still will be gripped in an unavoidable commitment to ten years of increased damage. This would then gradually return to pre-damage levels over the next 100 - 150 years.

This seems to be evidence that the global ecosystem's sink capacity to absorb CFC pollution has been vastly exceeded. The limits have been reached and exceeded, mankind is in for damage to environmental services, human health and food production. This is a good example because 85% of CFCs are released in the industrial north, but the main hole appeared in Antarctica in the ozone layer 20 kilometers up in the sky, showing the damage to be widespread and truly global in nature.

7. Fourth Evidence: Land Degradation

Land degradation, decreased productivity such as caused by accelerated soil erosion, salination and desertification, is only one of the many topics that could be included here. It is not new; land degraded thousands of years ago (e.g. Tigris-Euphrates) remains unproductive today. But the scale has mushroomed and is important because practically all (97%) food comes from land rather than from aquatic or ocean systems. As 35% of the earth's land already is degraded, and since this figure is increasing and largely irreversible in any timescale of interest to society, such degradation is a sign that we have exceeded the regenerative capacity of the earth's soil source.

Pimentel et al. (1987) found soil erosion to be serious in most of the world's agricultural areas, and that this problem is worsening as more marginal land is brought into production. Soil loss rates, generally ranging from 10 to 100 t/ha/yr, exceed soil formation rates by at least tenfold. Agriculture is leading to erosion, salination or waterlogging of possibly 6 million hectares per year: "a crisis seriously affecting the world food economy".

Exceeding the limits of this particular environmental source function raises food prices, and exacerbates income inequality, at a time that one billion people are already malnourished. As one third of developing country populations now faces fuelwood deficits, crop residues and dung are diverted from agriculture to fuel. Fuelwood overharvesting and this diversion intensify land degradation, hunger and poverty.

8. Fifth Evidence: Biodiversity

The scale of the human economy has grown so large that there is no longer room for all species in the ark. The rates of takeover of wildlife habitat and of species extinctions are the fastest they have ever been in recorded history and are accelerating. The world's richest species habitat, tropical forest, has already been 55% destroyed, the current rate exceeds 168,000 square kilometers per year. As the total number of species extant is not yet known to the nearest order of magnitude (5 million or 30 million or more), it is impossible to determine precise extinction rates. However,
conservative estimates put the rate at more than 5000 species of our inherited genetic library irreversibly extinguished each year. This is about 10,000 times as fast as pre-human extinction rates. Less conservative estimates put the rate at 150,000 species per year (Goodland 1991). Many find such anthropocentrism to be arrogant and immoral. It also increases risks of over/hoot. Built-in redundancy is a part of many biological systems, but we do not know how near thresholds are. Most extinctions from tropical deforestation (eg: colonization) today increase poverty -- tropical moist forest soils are fragile -- so we do not even have much of a beneficial tradeoff with development here.

9. Population

Brundtland is sensible on population: enough food is too expensive for one-fourth of the earth’s population today. Birthweight is declining in places. Poverty stimulates population growth. Direct poverty alleviation is essential; business as usual on poverty alleviation is immoral. MacNeill (1989) states it plainly: "... reducing rates of population growth ...." is an essential condition to achieve sustainability. This is as important, if not more so, in industrial countries as it is in developing countries. Industrial countries overconsume per capita, hence overpollute, so are responsible for by far the largest share of limits being reached. The richest 20% of the world consumes over 70% of the world's commercial energy. Thirteen nations already have achieved zero population growth, so it is not utopian to expect others to follow.

Developing countries contribute to exceeding limits because they are so populous today (77% of the world’s total), and increasing far faster than their economies can provide for them (90% of world population growth). Real incomes are declining in some areas. If left unchecked, it may be half way through the 21st century before the number of births will fall back even to current high levels. Developing countries' population growth alone would account for a 75% increase in their commercial energy consumption by 2025, even if per capita consumption remained at current inadequate levels (OTA 1991). These countries need so much scale growth that this can only be freed up by the transition to sustainability in industrial countries.

The poor must be given the chance, must be assisted, and will justifiably demand to reach at least minimally acceptable living standards by access to the remaining natural resource base. When industrial nations switch from input growth to qualitative development, more resources and environmental functions will be available for the South’s needed growth. This is a major role of the World Bank. It is in the interests of developing countries and the world commons not to follow the fossil fuel model. It is in the interest of industrial countries to subsidize alternatives, and this is an increasing role for the World Bank. This view is repeated by Dr. Qu Wenhu of Academica Sinica who says: ".... if 'needs' includes one automobile for each of a billion Chinese, then sustainable development is impossible ...." Developing populations account for only 17% of total commercial energy now, but unchecked this will almost double by 2020 (OTA 1991).

Merely meeting unmet demand for family planning would help enormously. Educating girls and providing them with credit for productive purposes and employment opportunities are probably the next most effective measures. A full 25% of US births, and a much larger number of developing country births, are to unmarried mothers, hence providing less child care. Most of these births are unwanted, which also tends to result in less care. Certainly, international development agencies should assist high population growth countries reduce to world averages as an urgent first step, instead of trying only to increase infrastructure without population measures.
10. Growth versus Development

To the extent the economic subsystem has indeed become large relative to the global ecosystem on which it depends, and the regenerative and assimilative capacities of its sources and sinks are being exceeded, then the growth called for by Brundtland will dangerously exacerbate surpassing the limits outlined above. Opinions differ. MacNeill (1989) claims "a minimum of 3% annual per capita income growth is needed to reach sustainability during the first part of the next century", and this would need higher growth in national income, given population trends. Hueting (1990) disagrees, concluding that for sustainability "... what we need least is an increase in national income". Sustainability will be achieved only to the extent quantitative throughput growth stabilizes and is replaced by qualitative development, holding inputs constant. Reverting to the scale of the economy -- population times per capita resource use -- per capita resource use must decline, as well as population.

Brundtland is excellent on three of the four necessary conditions. First, producing more with less (eg: conservation, efficiency, technological improvements and recycling). Japan excels in this regard, producing 81% more real output than it did in 1973 using the same amount of energy. Second, reducing the population explosion. Third, redistribution from overconsumers to the poor. Brundtland was probably being politically astute in leaving fuzzy the the fourth necessary condition to make all four sufficient to reach sustainability. This is the transition from input growth and growth in the scale of the economy over to qualitative development, holding the scale of the economy consistent with the regenerative and assimilative capacities of global life support systems. In several places the Brundtland Report hints at this. In qualitative, sustainable development production replaces depreciated assets, and births replace deaths, so that stocks of wealth and people are continually renewed and even improved (Daly 1990). A developing economy is getting better: wellbeing of the (stable) population improves. An economy growing in throughput is getting bigger, exceeding limits, damaging the self-repairing capacity of the planet.

To the extent our leaders recognize the fact that the globe has reached limits and decide to reduce further expansion in the scale of the economy, we must prevent hardship in this tremendous transition for poor countries. Brundtland commendably advocates growth for poor countries. But only raising the bottom without lowering the top will not permit sustainability (Haavelmo, 1990).

The poor need an irreducible minimum of basics -- food, clothing and shelter. These basics require throughput growth for poor countries, with compensating reductions in such growth in rich countries. Apart from colonial resource drawdowns, industrial country growth historically has increased markets for developing countries' raw materials, hence presumably benefiting poor countries, but it is industrial country growth that has to contract to free up ecological room for the minimum growth needed in poor country economies. Tinbergen and Hueting (1991) put it plainest: "... no further production growth in rich countries ...." All approaches to sustainability must internalize this constraint if the crucial goals of poverty alleviation and halting damage to global life support systems are to be approached.

11. Conclusion

When economies change from agrarian through industrial to more service oriented, then smokestack throughput growth may improve to growth less damaging of sources and sinks: coal and steel to fiber optics and electronics for example. We must speed to production which is less
throughput-intensive. We must accelerate technical improvements in resource productivity; Brundtland's "producing more with less". Presumably this is what the Brundtland commission and subsequent follow up authors (eg: MacNeill 1989) label "growth, but of a different kind." Vigorous promotion of this trend will indeed help the transition to sustainability, and is probably essential. It is also largely true that conservation and efficiency improvements and recycling are profitable, and will become much more so the instant environmental externalities (eg: carbon dioxide emissions) are internalized.

But it will be insufficient for four reasons. First, all growth consumes resources and produces wastes, even Brundtland's unspecified new type of growth. To the extent we have reached limits to the ecosystem's regenerative and assimilative capacities, throughput growth exceeding such limits will not herald sustainability. Second, the size of the service sector relative to the production of goods has limits. Third, even many services are fairly throughput-intensive, such as tourism, universities and hospitals. Fourth, and highly significant, is that less throughput-intensive growth is "hi-tech", hence the one place where there has to be more growth -- tiny, impoverished, developing-country economies -- are less likely to be able to afford Brundtland's "new" growth.

Part of the answer will be massive technology transfer from industrial countries to developing countries to offer them whatever throughput-neutral or throughput-minimal technologies are available. This transfer is presaged by the US$1.5 bn "Global Environment Facility" of UNEP, UNDP and the World Bank which will start in 1991 to finance improvements not yet fully "economic," but which benefit the global commons.

This chapter is not primarily about how to approach sustainability; that is well documented elsewhere (Adams 1990, Agarwal and Narain 1990, Chambers et al. 1990, Conroy and Litvinoff 1988, Goldsmith, Hildyard and Bunyard 1990). Nor is it about the economic and political difficulties of reaching sustainability, such as the pricing of the infinite (eg: ozone shield), endlessly debatable (eg: biodiversity), or pricing for posterity what we cannot price today. That is admirably argued by Daly and Cobb (1989), Daly (1989, 1990, 1991), El Serafy (1991), and by Costanza (1991). It is about the need to recognize the imminence of limits to throughput growth, while alleviating poverty in the world. Many local thresholds have been broached because of population pressures and poverty; global thresholds are being broached by industrial countries' overconsumption.

To conclude on an optimistic note: OECD found in 1984 that environmental expenditures are good for the economy and good for employment. The 1988 Worldwatch study (Brown, 1988) speculated that a sustainability could be achieved by the year 2000 with additional annual expenditures increasing gradually to $150 bn in 2000. Most measures needed to approach sustainability are beneficial also for other reasons (eg: fuel efficiency). The world's nations have annually funded UNEP with about $30 million, although they propose now "to consider" increasing this sum to $100 million. Money is available; it is not financial capital shortage that limits the economy anymore. It is shortages of both natural capital, as well as of political will in the industrialized world. Yet we fail to follow economic logic and invest in the limiting factor.

Many nations spend less on environment, health, education and welfare than they do on arms, which now annually total $1 trillion. Global security is increasingly prejudiced by source and sink constraints as recent natural resource wars have shown, such as the 1974 "Cod" war between UK and Iceland, the 1969 "Football" war between overpopulated El Salvador and under-populated Honduras, and the 1991 Gulf war. As soon as damage to global life-support systems is perceived as far riskier
than military threats, more prudent reallocation will promptly follow.

Acknowledgements

I acknowledge the useful comments of Paul Ehrlich, Stein Hansen, Roefie Hueting, Frederik van Bolhuis, Sandra Postel, Jane Pratt and Richard Norgaard.

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Environmentally Sustainable Economic Development Building on Brundtland

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July 1991

Environment Working Paper No. 46

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