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Hermele, Kenneth

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LUND UNIVERSITY

PO Box 117  
221 00 Lund  
+46 46-222 00 00



**LUND UNIVERSITY**  
Faculty of Social Sciences

## **The Use and Misuse of Reductionist Measures of the Nature-Economy Interface**

By Kenneth Hermele<sup>1</sup>, June, 2009

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Science and Policy for a Sustainable Future,  
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### Abstract

1. What distinguishes ecological from environmental economics?
2. Monetary reductionisms
3. Ecological reductionisms
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### **Abstract**

Measures trying to capture the relationship between the economy and nature can be divided into those that assume that economic and natural resources are interchangeable, and those that assume that there is no such substitutability (as a rule). Following this distinction, two concepts of sustainability exist, one weak (based on substitutability) and one strong (complementarity), with each conception associated with a separate discipline, the weak with environmental economics, and the strong with ecological economics.

Although environmental economists (the mainstream) are rightly criticized for neglecting or for failing to grasp the physical aspects of the nature-economy relationship, this should not lead us into substituting one deterministic position for another, ecological or material determinism for monetary determinism.

I argue that both perspectives – environmental economics and ecological economics – use reductionist metrics. For instance, ecologists apply reductionist measures to value ecosystem services (in a number of studies during the last decade), and ecological economists attempt a similar calculus in order to sum up economic, ecological and welfare aspects of a society (eg ISEW). Both efforts results in a possibility to compare with the reductionist measure GDP dollar for dollar. Although the conclusions forthcoming from such exercises may be the opposite of what the GDP shows, the underlying reductionist logic is similar. Even approaches that claim to be free of economic reductionism may still apply reductionist metrics

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<sup>1</sup> PhD candidate, Human Ecology Division, Lund University. E-mail: [kenneth.hermele@hek.lu.se](mailto:kenneth.hermele@hek.lu.se),  
phone +46 (0)739 49 45 64.web page: [www.hek.lu.se/personal/hermele-kenneth](http://www.hek.lu.se/personal/hermele-kenneth).

(eg Ecological Footprint analyses, Material Flow Analyses), which leads to a risk of reducing all values to one dimension, albeit physical and not monetary.

This should not refrain us from paying attention to the contradicting conclusions reached when you apply a real non-reductionist perspective (eg Millennium Ecosystem Assessment, MA) as compared to a reductionist one (eg World Bank's Wealth of Nations). But the difference in outcome is not only caused by one measure constituting a collection of physical indices, i.e. non-reductionist, while the other is expressed in monetary terms, and hence reductionist, but also from the underlying assumptions which preclude the outcome.

Hence, economic reductionist metrics may yield conclusions which seem correct to a non-reductionist, ecological perspective. Nevertheless, such measures – screaming money to mainstream economists and politicians (Daly) – are to be avoided as the information that they convey is critically flawed.

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”Why do some of the best minds in economics work on environmental problems? In part, at least, because they think that environmental problems raise issues that matter for the whole of economics, and because they think that understanding environmental problems helps us to understand important issues in economics as a whole.”<sup>2</sup>

It is easy to make fun of mainstream, environmental economists when they argue about the nature-economy interface. In the above quote, taken from one of the leading environmental economists, Geoffrey Heal – perhaps even one of the best minds? – our thoughts are pushed in an unexpected direction. The environment is worth studying because it can contribute something to the economics discipline, it is not the issues and conflicts – e.g. growth vs. sustainability – as such that matter, not even what they tell us about the economy, but what they teach us about economics.

Maybe it was this kind of "utility" that made Paul Erlich phrase the predicament of human kind in such a comic way: if alarmists should turn out to be realists, it

“could spell the end of civilization as we know it, resulting in a dramatic decline in the employment possibilities of both economists and ecologists.”<sup>3</sup>

Not to speak of other drawbacks that may be caused by the end of civilisation, of course.

A happier argument is presented by another leading environmental economist, Partha Dasgupta, who claims that ecologists tend to overlook that

”economic growth itself has brought with it improvements in the quality of a number of environmental resources.”<sup>4</sup>

His argument is worth quoting at some length:

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<sup>2</sup> Heal 2007: 7.

<sup>3</sup> Ehrlich 2008:3.

<sup>4</sup> Dasgupta forthcoming, p 5.

”The large-scale availability of potable water and the increased protection of human populations against both water- and air-borne diseases in industrial countries have come with the economic growth those countries have enjoyed over past 200 years. Moreover, the physical environment inside the home has improved beyond measure. Cooking in South Asia continues to be a central cause of respiratory illnesses among women. Growth in scientific knowledge, investment in public infrastructure, and universal education in advanced industrial countries have meant that citizens there have far greater knowledge of environmental hazards than their counterparts in poor regions and have the resources to avoid them. Such positive links between economic growth and environmental quality often go unacknowledged by environmentalists in the West.”

If this argument was intended to defend economic growth against ecological criticisms, it misses its goal. Dasgupta disregards that at least some of the problems that rich people have the knowledge and understanding to avoid, have been caused by the very same process of economic growth that has given them the wherewithal to avoid them. It looks like a perfect circular reasoning: the more economic growth we “enjoy”, the more knowledge and understanding we need – and get – in order to avoid the problems that that growth brought about. Not to speak of the fact that Dasgupta’s examples of environmental resources are limited to the realm of health (“the physical environment inside the home”) while ecosystems, and the services they perform, are left out of the picture. What happened to the impact of growth on climate change, or biodiversity, or fish stocks?

### 1. What distinguishes ecological from environmental economics?

Dasgupta’s arguments are not convincing, at least not to an ecological economist. Still it may be asked, whether the distinction environmental economics – ecological economics really is a meaningful one, is it not only a play with words? Dasgupta certainly seems to think so, as he erases all differences between the two by lumping them together into one category, economists who study the environment and who are in opposition to the mainstream of the economists’ profession:

“environmental and resource economists, or *ecological economics* for short, remains isolated from the main body of contemporary economic thinking.”<sup>5</sup>

I read this as a lament: it would be better if environmental economists were not isolated from the mainstream, but it is unclear on whose terms such integration should be undertaken, are the rules of the game established by the mainstream or by the new perspective?

Ecological economists maintain that there is a sharp dividing line between themselves and environmental economists, based upon the latter group’s disinterest in, not to say ignorance

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<sup>5</sup> Dasgupta op cit:7, italics in the original. Ehrlich 2008 makes a similar point: “Environment and resource economists (hereafter ‘ecological economists’, which I consider to be an identical group)”.

of, natural science.<sup>6</sup> Martinez-Alier makes the point even more forcefully by equating ecological economics with biophysical economics.<sup>7</sup>

Table 1 presents some of the salient differences in the world views of environmental as compared to ecological economics. While environmental economics is concerned with efficiency, assumes substitutability between economic and ecological resources (i.e. it has a weak definition of sustainability) and sees its arena as limited to economic measures and markets, ecological economics has a completely different set-up of assumptions and concerns.

**Table 1. Differences of conception**

	<b>Environmental economics</b>	<b>Ecological economics</b>
Main task	Efficiency: efficient distribution of scarce resources	Scale: the capacity of the ecosystem to sustain the economy
Main assumption	Substitutability	Complementarity
Conception of sustainability	Weak	Strong
Main measure of success or failure	GDP corrected for environmental costs	Physical indicators in relation to ecological carrying capacity
Main institutions	Markets	Physical limits and markets

*Source:* Based on Daly 1992

This leads us directly into the hotly debated area of reductionism. Daly has distinguished three options for discussing the interface nature-economy, two of which are based on reductionist logic.<sup>8</sup>

Economic imperialism. In this perspective, the problem regarding the relationship economy-nature is caused by the fact that some economic processes and effects have no monetary costs, they are external to the market and are hence called externalities (ie. external to the market where monetary values are attributed). Consequently, the economic imperialistic perspective tries to resolve the contradiction nature-economy by internalizing the externalities, by giving non-market relations a monetary value, in fact by making everything “economy”.

By putting a price on nature, we risk confounding value with the price tag, a mistake which is well-known in economics as the price-value-paradox. Why are essential goods such as water and air free or very cheap, while unnecessary things like diamonds cost very dearly? The solution to the paradox is that prices do not reflect value or usefulness, but scarcity, which means that essential goods and services provided by nature may be free or at best at priced at levels which fail to reflect their life supporting functions.

A telling case in point is the way William Nordhaus, another leading environmental economist, downplays the possible impact of climate change on the US economy by arguing that agriculture only accounts for an insignificant 3 percent of GDP.<sup>9</sup> But although agriculture may be a small share of the economy, it nevertheless is a precondition for a number of goods and services, which society reaps, eg. food, water, air, landscape, forestry, grazing land, etc,

<sup>6</sup> This is brought home by the fact that two influential and early studies of ecological economics include physics in their titles, see Georgescu-Roegen 1971 (the entropy law) and Martinez-Alier 1990 (energy, original Catalan edition 1984). Similarly, the original 1977 sub-title of Daly 1992 reads “The Economics of Biophysical Equilibrium and Moral Growth”.

<sup>7</sup> Martinez-Alier 1990: viii.

<sup>8</sup> The following is based upon Daly 1992, chapter 11.

<sup>9</sup> Quoted in Daly 1996:63-64.

etc. The share of the GDP is simply not a meaningful measure of the importance of agriculture.

The economic imperialistic view fails to tackle the essential question of scale of the economy vis-à-vis the life supporting services provided by the ecosystems. While prices are essential for assuring efficient allocation of scarce resources, they cannot resolve the task of deciding which overall scale the economy should assume in order to assure ecological sustainability. With Daly's image: if the economy is a ship, the economic imperialistic view may assure that it is efficiently loaded, but not that it can carry its load:

“It is of little comfort if an overloaded ship founders efficiently!”<sup>10</sup>

### Ecological reductionism.

In opposition to economic imperialism, an ecological perspective may seem an obvious choice, but it has a similar danger of reducing all values to one dimension, albeit physical and not monetary. Although the imperialistic position rightly is criticized for neglecting the physical aspects of the nature-economy relationship, this should not lead us into substituting ecological reductionism for monetary reductionism. The economy, as well as nature, must be given reasonable representation when trying to understand the interface.

So although one would be correct in claiming that the economy and nature are incommensurable entities, this should not lead to an acceptance of an evaluation by means of physical or energy indicators alone:

“Incommensurability, i.e. the absence of a common unit of measurement across plural values, entails the rejection not just of monetary reductionism but also any physical reductionism (e.g. eco-energetic valuation).”<sup>11</sup>

This, of course, does not amount to saying that physical measures have no role to play, only that they should be applied where they are suitable. In this sense, monetary and physical indicators are similar: they are useful only in the right context.

The economy as an open, dependent sub-system of the ecosystem. This leaves us with a third, middle-of-the-road position. Contradicting the economic imperialist position, it stresses the scale of the economy as the crucial issue to measure, and it rejects measuring everything in money. When it comes to the scale of the economy, however, it must be established by some mechanism other than that provided by the market; here, physical indicators cannot be replaced by more or less sophisticated monetary calculations.

But the third road simultaneously opposes ecological reductionism and wants to see the two side by side: market mechanism for allocational efficiency and freedom of choice within the limits of acceptable scale, a combination of physical limits for the scale of the economic throughput, with economic metrics for the economy.

Here we may find a dividing line among economists that go far back in the history of economics, separating romantic and neo-classical economists. While environmental (i.e. neoclassical) economists are prone to reduce their value compass to welfare or happiness, romantic economists

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<sup>10</sup> Daly & Farley 2004:4.

<sup>11</sup> Martinez-Alier et al 1998:280.

"will argue that we should, wherever possible, make available data, which analyse the impact of policy in respect of each relevant goal separately – rather than deciding ahead of time how to weight these goals to reflect their notional contribution to some catch-all goal of welfare."<sup>12</sup>

Nice, isn't it, to think that ecological economists in fact are romantics, and to consider this as a positive thing?

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Although environmental economists fall short of understanding, let alone embracing, the position of the economy as a subsystem of the ecosystem, we should nevertheless recognize that environmental economists at least do show an interest in the relationship nature-economy, something which distinguishes them from the great majority of their fellow economists. Still, I would argue that economic reductionism is not an improvement but hides and confuses the real issues of scale by focussing on efficiency and market prices. But the reason why you could end up welcoming the economic reductionist approach is that environmental economics, with all its shortcomings, is still better than the record presented by mainstream economics as a whole, as testified by a recent review of the major themes that leading mainstream economists have worked on. Paul Erhlich has noted that a number of crucial problem areas – crucial to environmental as well as ecological economics – have been neglected, as he could not find the following words in the titles of the most quoted articles in 41 of the most prestigious economics journals during the last 35 years:

abatement, adaptation, AIDS, aquifer, biotic, biosphere, cap and trade, carbon, carrying capacity, child, climate, depletion, discount(ing), disease, drugs, ecology, ecosystem, education, enjoyment, entropy, epidemic, ethics, fertility, footprint, forest, fossil, free-rider, fuel wood, gender, genuine investment, genuine wealth, Gini, global, globalization, health, inequity, infant, justice, life expectancy, literacy, maldistribution, market failure, Montreal, mortality, natural capital, natural resource, nuclear, open access, overdevelopment, ozone, Pigouvian, pollution, poor, population, poverty, property rights, public good, redistribution, satisfaction, shadow price, social capital, soil, solar, steady-state, substitute(ability), tax shifting, timber, toxic, trade, tragedy, treaty, utility, valuation, war, warming, water, well-being, women.<sup>13</sup>

One may well ask what mainstream economists dedicate themselves to studying. Maybe it was this lacuna when it comes to what is studied and discussed among traditional, neo-classical economists – this absence of real life-and-death-issues – that led an ecological economist like Herman Daly to defend his choice of joining the World Bank in 1988 thus:

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<sup>12</sup> Bronk 2009:184.

<sup>13</sup> Ehrlich 2008. The 41 journals (see Kim et al 2006) did not include any environmental or resource economics journals. The 146 articles had at least 500 citations each. To be fair: in the titles of the 146 articles surveyed, the word “energy”, “migration”, “inequality”, “externalities”, “opportunity”, and “power” appeared once, and “environment”, “consumption” and “distribution(al)” twice, mostly as far back as 1970-1975.

“my present livelihood as a World Bank economist has to date given me somewhat less cause for shame than my previous livelihood as a university professor of economics.”<sup>14</sup>

Or put in other words: Compared to mainstream economics, the environmental branch of economics may be considered to be a step in the right direction: at least they have realized that there is a problem area as far as the economy-environment interface is concerned.

## 2. Monetary reductionisms

So the interest of the environmental economists in the nature – economy interface is an advance, although it simultaneously may be questioned as constituting a "commodification" of nature. But the fact that they assume substitutability – sometimes even going as far as to assume that man-made capital not only can replace but that it actually constitutes an improvement over the natural capital that it has destroyed<sup>15</sup> – does not preclude them from recognizing that one kind of capital resource may be exploited at such a rate that other kinds of capital resources are not abundant enough to compensate for the loss. One example, taken from an influential paper by yet another group of leading environmental economists:

“We also find evidence that several nations of the globe are failing to meet a sustainability criterion: their investments in human and manufactured capital are not sufficient to offset the depletion of natural capital.”<sup>16</sup>

Here, not even substitutability suffices to secure sustainability. Is it a symptom that even environmental economists realize that something is seriously wrong?

Ecological services valued in money. But in spite of such progress, environmental economists show their interest for nature in a confusing way, and preferably by applying economic concepts to nature, specifically to the ecological services provided. This is brought out quite openly in a (popular, non-academic) explanation of the topic “valuing ecosystem services” written by two leading environmental economists:

”A new paradigm is emerging in environmental economics. It views the natural environment as a form of capital asset, natural capital. This is *fully in keeping* with what is happening in other areas of economics, where alternative forms of capital are central to analyses that have become influential – human capital, intellectual capital, and social capital being notable examples.”<sup>17</sup>

Although it is correct to say that an econom(ist)ic language has succeeded in permeating other disciplines (sociologists talk of social capital rather than trust and social cohesion; strengthening of education and improving knowledge becomes “investing in human capital”, and so on), and although you may well consider nature to be a provider of ecosystem services, nature also distinguishes itself from economic forms of capital by the fact that it as a rule cannot be created by human endeavour (although it certainly may be destroyed by it).

<sup>14</sup> Daly 1992:14. He added: “This personal judgment is of course subject to revision as life goes on.” In 1994 Daly changed his verdict and left the World Bank after six years.

<sup>15</sup> This is not a necessary conclusion of assuming general substitutability, but it has played a role in the Swedish discussion among economists, see Radetzki 2001 for a defence of this stance.

<sup>16</sup> Arrow et al 2004:167.

<sup>17</sup> Heal and Barbier 2006:1, italics added.

This should also be clear to environmental economists, if they consider the scope of ecosystem services that need to be valued. Here is one list of relevant "services" to be accounted for, provided by a group of prominent scientists: food (e.g. oceans), sources of wild medicinal plants (forests), water purification (wetlands), flood control (wetlands), erosion control (forests, wetlands), carbon sequestration (forests, oceans), habitat for wildlife (most ecosystems), reservoir of biological diversity, nutrient recycling, detoxification of chemicals, recreation and outdoor adventure, aesthetic enjoyment, solitude, and spiritual fulfilment.<sup>18</sup>

But with the audacity of a profession that never loses hope, environmental economists seem to think that almost any monetary measure – irrespective of its weaknesses – is to be preferred to none. They inadvertently give away that they apply a totally anthropocentric perspective by defining what they are about to give monetary value:

“Broadly defined, ecosystem services are the benefits people obtain from ecosystems”.<sup>19</sup>

Similarly, a joint study by the World Conservation Union, the Nature Conservancy and the World Bank brags about their lopsided approach:

“The focus of this paper is decidedly anthropocentric: the ecosystem benefits we consider are those that contribute to human well-being.”<sup>20</sup>

One is left wondering if other ecosystem benefits exist which do not contribute to human well-being in one way or the other, and which therefore are left out of the calculus.<sup>21</sup>

Monetary exercises are frequently justified as a means in order to be invited to the negotiating table where everybody speaks money, politicians as well as their advisors. So argues Herman Daly, in defence of monetary reductionism when valuing ecosystem services:

“we rely on marginal valuation because that is the way the market works and we want to come up with measures that are comparable to our usual economic measure.”<sup>22</sup>

I am not convinced that this argument in favour of accepting economic reductionism holds water. Take the calculations presented by a group of researchers which concluded that global ecosystem services provided were at least of the order of magnitude of the global economy.<sup>23</sup> The authors of course recognize the daunting difficulties in arriving at meaningful measures, e.g. that “ecological services are only substitutable up to a point” which means that the value

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<sup>18</sup> Bingham et al 1995: 77.

<sup>19</sup> Heal & Barbier 2006:2.

<sup>20</sup> IUCN et al 2004:4.

<sup>21</sup> A similar confusion is evident in the argument of the leading (!) Swedish environmental economist Radetzki (2001), who claims to deal with the "micro environment", i.e. that which influences humans, and not "nature as such", i.e. the "macro-environment", which he purposefully disregards.

<sup>22</sup> Daly 1998:21.

<sup>23</sup> Costanza et al 1997:257. The ecosystem services considered were gas regulation, climate regulation, disturbance regulation, water regulation, water supply, erosion control and sediment retention, soil formation, nutrient recycling, waste treatment, pollination, biological control, refugia, food production, raw materials, genetic resources, recreation, and cultural services.

of their services would move towards infinity once the irreplaceable service approaches zero, or some minimum necessary level of service.

Still, bold calculations are carried out and the value of ecosystem services performed is found to be in the range of 16-54 trillion USD annually, with an average value of 33 trillion USD. Since the global GDP is about 18 trillion USD, ecosystem services may be understood to be of staggering importance. The conclusion is nevertheless surprisingly weak:

“We must begin to give the natural capital stock that produces these services adequate weight in the decision making process, otherwise current and continued human welfare may drastically suffer.”<sup>24</sup>

This way of calculating the value of ecosystem services was subsequently questioned for being “profoundly flawed, both conceptually and methodologically”.<sup>25</sup> In their own defence, the original group of scientists replied:

“Why would one want to measure the aggregate value of ecosystem services [...] It is [...] necessary in order to address the question of what is the optimum ‘scale’ or size of the economy relative to the ecological life support system. To address this question one must be able to directly compare the value of ecosystem services lost with the value of other economic services gained.”<sup>26</sup>

But this is not correct: although the argument follows in the footsteps of Herman Daly and his concern for the scale of the economy, scale is not measured in monetary terms but in physical. The question of scale has everything to do with ecological systems' capacity to absorb waste and provide services, and nothing to do with how the market values such services, nor with whether they can be compensated for by economic activities.

Once you have begun to reason along this economic logic, it is hard to stop, and the same group of scientists (somewhat re-arranged) subsequently presented a new estimate of the annual value of ecological services provided, based on less brave assumptions, which concluded that human utilization of ecosystems leads to a loss of services valued at only 250 billion USD per year (for six ecosystems), based on a comparison of services delivered by a biome when relatively intact, and when converted to typical forms of human use. The conclusion, just as before, is surprisingly mild:

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<sup>24</sup> Costanza et al 1997:259.

<sup>25</sup> IUCN et al 2004:17. The points highlighted here were, among others, that the study used specific research on local situations to reach conclusions that were said to hold true for the earth as a whole, and that the conclusions of the study were useless since political decision-making is not aided by knowing the total value of ecosystem services provided since it is the incremental losses that would occur as a consequence of a contemplated specific measure or project. Furthermore, the critique stressed that the group had committed the usual error of non-economists to confound average with marginal value; it is the marginal value that decides the price and hence the real value. The principle is illustrated by the water-diamond paradox; it is the marginal value that makes water cheap and diamonds expensive on the market, hence a calculation of the value of ecosystem services should be built on marginal reasoning.

<sup>26</sup> Costanza et al 1998:68.

”a clear and compelling economic case, alongside sociocultural and moral arguments, for us to strengthen attempts to conserve what remains of natural ecosystems.”<sup>27</sup>

Still the monetary measure has an advantage over physical measures by giving the impression of clarity (or perhaps I should say a false impression), when compared to the physical measures also presented by the same study: the six ecosystems considered suffered from a net loss of 1.2 percent annually (measured in areas or in abundance of associated vertebrate populations).<sup>28</sup> How many politicians, reporters or citizens feel alarmed by such naked facts?

Welfare and sustainability. But valuing ecosystem services in monetary terms can still be seen as a cautious undertaking, compared to what is being attempted when economists argue in favour of metrics that cover economic, social and environmental aspects of reality, as in the attempt to calculate an Index of Sustainable Economic Welfare. ISEW.<sup>29</sup> Taking as a point of departure what every economist knows (or at least should know), viz. that GDP is not a measure of welfare –the GDP is recalculated in order to arrive at an indicator that captures economic as well as welfare considerations, while simultaneously taking nature into account.<sup>30</sup>

The ISEW being a monetary measure, it is comparable to the GDP. As its designers recently explained, they

”wanted to engage orthodox economists in discussion, and knew that unless we to some extent played by their rules they would ignore us.”<sup>31</sup>

The general pattern is that GDP and ISEW follow the same path of growth from 1950 to about 1970, i.e. during the golden era of capitalist development post World War II. During the epoch, GDP in fact manages to capture the real improvement in sustainability and welfare, at least if we are to believe in the ISEW. But beginning in the 1980's, the two measures begin to move apart. In spite of economic growth, the other components – especially income distribution and environmental deterioration – tend to press the index down. While GDP grows, the ISEW indicates that sustainable welfare is diminishing.

Two comments may be offered here. Firstly, and strangely enough, the proponents of the ISEW do not even bother to discuss the problematic aspect of this measure. The substitutability that the measure assumes makes it in fact even “weaker” in terms of sustainability than the GDP.<sup>32</sup> Secondly, the ISEW is set in a national frame, and no account

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<sup>27</sup> Balmford et al 2002:951. The ecosystems considered are temperate/boreal forests, seagrass, tropical forests, marine populations, freshwater, and mangroves.

<sup>28</sup> Op cit, p 952.

<sup>29</sup> See Daly & Cobb 1990, Appendix, and Jackson & Marks 1994.

<sup>30</sup> While the GDP does not differentiate among its components – positive as well as negative economic activities are equally cherished – the ISEW does not include re-investments (on account of them not constituting economic growth but only a repair or a replacement of already existing stock of infrastructure etc), defensive or negative expenditure (such as environmental protection and cleaning up costs, commuting travel, tobacco commercials). Finally this income measure is weighted by the income distribution, in support of the argument that a more equal distribution entails a higher level of welfare for a given population. The result is an index of sustainable economic welfare based on substitutability among the components that make up the index.

<sup>31</sup> Daly & Cobb 2007:xx.

<sup>32</sup> Also note that the ISEW is not actually an index but a monetary measure. The ISEW is sometimes criticized for being based on questionable value judgements (such as deducting commuting costs for reducing commuters’

is taken of the fact that environmental loads are displaced through international trade. But it is of course nice to be able to “show” that the real welfare of countries is something else than what is captured by the GDP.

Net Adjusted Savings. Constructing such substitutable measures as the ISEW, thus accepting a weak definition of sustainability, is not unproblematic, especially not when the exercise is seen as being a success and gains followers, as happened with the ISEW. This is also recognized by the originators of ISEW.<sup>33</sup> Nevertheless, it is a dangerous path, as evidenced by one attempt to counter the ISEW which recently was presented by the World Bank. It has elaborated its own measure of welfare, based on a definition where welfare is constituted by a limited number of substitutable categories of “capital”. The way to go about maximizing future income growth (that is, achieve sustainability) is summarized as follow:

“when exploiting natural resources, save an *amount equal to the rent* from those resources to sustain the highest possible level of consumption.”<sup>34</sup>

This is the same thing as assuming total substitutability, all concerns with the economy's scale and the limits established by nature disappear as long as society saves a monetary value that is equal to the rent that you forego when the natural resources are exploited. It is no wonder then that the World Bank team talks about reality as if they were stock brokers:

“Certain assets in the portfolio are exhaustible and can only be transformed into other assets through investment of the resource rents.”<sup>35</sup>

But this is not all. The World Bank study acknowledges serious lack of data when it comes to putting a price tag on fish stocks and subsoil water extraction. Most surprisingly, for an indicator that wants to measure genuine savings, “environmental services that underpin human societies and economies are not measured explicitly”.

With these caveats, the World Bank bravely attempts to measure “genuine savings” in a country by adjusting GDP for depreciation (which is the same procedure that the ISEW uses, i.e. the net domestic product replaces the gross), adding investments in human capital (as measured by education expenditure) and finally deducting the costs for depletion of minerals, energy, forests, and damages from local and global air pollution. A catch-all category is added, called “intangible capital” which is assumed to capture institutional quality, social capital, etc.<sup>36</sup>

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welfare), but it is not more arbitrary than assuming that all economic activities have the same positive welfare implications.

<sup>33</sup> See Daly & Cobb 2007 where they lament that “the attention paid to the ISEW has, contrary to our wishes, probably deflected attention from the more basic person-in-community argument.” But they go on to reaffirm their procedure: “In the Middle Ages holy thought had to be expressed in Latin; today it must be expressed in numbers.”

<sup>34</sup> World Bank 2005:102, italics added.

<sup>35</sup> Op cit, p viii. The measure was earlier called Genuine Savings Indicator, but “genuine” or not, the confusion is the same, and a similar argument can be made based upon how much compensation people are willing to accept in exchange for “ecological services” foregone. If you assume that people are quite keen to accept compensation, then this amounts to the same thing as a high degree of substitutability. See Saltelli et al 2007.

<sup>36</sup> The World Bank really does not know what is hidden in this intangible category, it is calculated as a residual to account for the difference between the estimated real wealth (arrived at by using the concept of assumed future consumption streams and discounting it to the present at 4 percent) and the component that the World Bank has tried to measure (produced and natural capital). World Bank 2005:21-22.

The conclusion is what one would expect: intangible capital explains 85 percent of the total wealth of rich countries, while produced capital only accounts for 14 percent, and natural capital for a dismal one percent! Poor countries, on the other hand, are said to be much more dependent on natural capital, 26 percent of their total wealth on average belongs to this category, still not very likely to come close to the true dependency, taking into account what we know about the many countries which are extremely dependent on agriculture and exploitation of minerals.

The recommendation could have been foreseen: poor countries would be wise to care more about their natural capital. And the report puts this in so weak words that you would be forgiven for assuming that they are trying to down-play their own work. Under the ambitious heading Putting It All Together, the World Bank concludes:

“The evidence in this volume suggest that investments in produced capital, human capital, and governance, combined with saving efforts aimed at offsetting the depletion of natural resources, can lead to future welfare increases in developing countries.”<sup>37</sup>

Although the conclusion reached by the World Bank may not be very impressive, it plays an important role for the argument environmental economists put together regarding the nature-economy interface. First a group of environmental scientists produce a joint article, where economist and Nobel laureate Kenneth Arrow heads the impressive list of authors.<sup>38</sup> With the help of the method for calculating real wealth elaborated by the World Bank, they subsequently present their conclusion: poor countries are in reality doing worse than it seems when using traditional growth figures, which also holds true for rich countries (the paper only includes Great Britain and the United States). But while poor countries often end up in the negative or with very low growth rates, the (two) rich countries manage to stay on the positive side, which means that their economic trajectories are sustainable.

But can these conclusions be trusted? One can be doubtful, when one realizes that the most sustainable country in this optic is China.<sup>39</sup> But environmental economists are not deterred. Commenting on the “comprehensive measure of wealth”, Dasgupta's phrase for the Net Adjusted Savings indicator, he concludes that China, in contrast to Sub-Saharan Africa and South Asia, has

“followed a path of sustainable development. The macroeconomic history of nations looks very different when nature is included as a capital asset in economic activity.”<sup>40</sup>

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<sup>37</sup> Op cit, p xiv.

<sup>38</sup> Arrow et al 2004. Among the authors are several of the economists and scientists that I have referred to, Dasgupta, Ehrlich and Heal, as well as one that soon will appear below, Schneider.

<sup>39</sup> The “real” or “genuine” growth rates are of course much lower than the traditional savings and growth rates for China, but still impressive, 8 percent per year 1970-2000. This group of leading minds in economics realize that their method may be far from flawless: environmental loads created by emissions in a certain country is only registered as influencing the real wealth of the emitter, not of countries worldwide although the effect is global; and China's result may be caused by the fact that its “estimates of genuine investment do not include soil erosion or urban pollution, both of which are thought by experts to be especially problematic in China.” Op cit, p 162 and 165, respectively.

<sup>40</sup> Dasgupta 2008:60.

Indeed it does, and it looks very different from what you can observe with physical indicators of sustainability.

Nevertheless, the arguments and calculations may have an aura of reliability since growth and savings rates for all countries are adjusted downwards, in some cases transforming growth into retrogression, especially for oil-rich countries of the Middle East and North Africa. But then comes the crunch: after identifying the reason for declining "real wealth" – "natural capital" is being depleted – the authors go on to recommend more investments *in the economy*, not even in an attempt to increase efficiency or in substituting renewable for non-renewable resources, like environmental economists normally do. But more economic growth is likely to exacerbate the problem "on the natural side" by increasing the throughput of materials and by increasing waste.

Thus, the reasoning of the Genuine Savings indicator is flawed: no attempt is made to measure the degree of substitutability, although many environmental economists recognize that it is far from perfect.

### 3. Ecological reductionisms

Physical indicators are appealing to ecological economists as they negate the assumption of weak sustainability, that is they do not attempt to lump together economic and ecological aspects in one measure. But many ecological measures nevertheless try to come up with one sole indicator for the ecological sphere as a whole, which opens them to similar objections as other reductionist procedures: they attempt to measure incommensurable ecological states.

Environmental Performance Index. Let us start with one of the most misleading measures, the Environmental Performance Index, IPE. It is nevertheless one of the most prestigious collections of indicators, backed by Yale and Columbia universities in collaboration with the World Economic Forum.

The two main concerns of the EPI, environmental health and ecosystem vitality, are each given equal weight in the index. Each concern is measured by a number of indicators, 25 in total, given different weights. The results are then summed up in an index, where countries are ranked from 1 to 100, or from worst to best performer. Already here it must be noted, that the category "environmental health" – half of the EPI – is a misnomer, it actually deals with human health, as it is affected by the environment (see Table 2).

EPI established limits – best and worst performance, respectively – by "capping" the admissible values so that 90-95 percent of the observed values fall within the ensuing spread of observations. This means that outliers, extreme country values that lie outside these limits, are reduced to fall within the spread considered to be normal. In other words, best *performance* is celebrated by the EPI with maximum points. Thus EPI measures the extent to which countries adapt best practice, or attain best results, today, not their distance from what ecological systems require or some other notion of ecological sustainability in the strong sense.

**Table 2. The Environmental Performance Index**

<b>EPI</b>	<b>Weight, %</b>
<b>Environmental health</b>	<b>50</b>
- Environmental burden of disease	25 12.5, of which sanitation 6.25, drinking water 6.25
- Water	12.5, of which urban particulates 5, indoor air pollution 5, ozone 2.5
- Air pollution	
<b>Ecosystem vitality</b>	<b>50</b>
- Air pollution	2.5, of which ozone 1.25, sulphur dioxide 1.25
- Water	7.5, of which water quality 3.75, water stress 3.75
- Biodiversity & habitat	7.5, of which conservation risk 1.88, effective conservation 1.88, critical habitat 1.88, marine protected areas 1.88
- Natural resources	7.5, of which forestry 2.5, fisheries 2.5, agriculture 2.5
- Climate change	25, of which emission per capita 8.33, emissions/electricity generated 8.33, industrial carbon intensity 8.33

Source: [www.epi.yale.edu](http://www.epi.yale.edu)

The EPI concludes that “wealth correlates highly with EPI scores”, i.e. that rich countries perform better than poor. The EPI justifies this bias<sup>41</sup> by claiming that the index can be used for peer country comparisons, some countries outperform (or underperform) their peers (which here only refers to countries of the same geographic region, which is odd since the USA and Canada are then peers with Haiti and Bolivia, while Romania is compared to Switzerland).

But should you really pay any attention to an index that lets the ten best environmental performers be the following countries (which all have EPI around or above 90, indicating that their performance is close to perfect, or at least as good as it gets): Switzerland 94, Sweden 93, Norway 93, Finland 91, Costa Rica 91, Austria 89, New Zealand 89, Latvia 89, Colombia, 88, and France 88 (out of a maximum of 100 EPI).<sup>42</sup>

Environmental Vulnerability Index. A similar approach to the EPI is the Environmental Vulnerability Index, EVI, elaborated specifically for small island development states (SIDS).<sup>43</sup> The EVI is based on 50 indicators, from conflicts, over volcanic activities to winds

<sup>41</sup> The bias arises because the EPI mixes environmental concerns and considerations with social and health related aspects; the latter are positively correlated with economic growth. The situation is made worse by the fact that it is only such non-environmental aspects of reality which drives the index and explains the country scores. The primary drivers of the EPI rank are the categories of "environmental health". The "ecosystem vitality" indicators are not decisive – not an inconsequential objection to an environmental performance index. See Saisana & Saltelli 2008:2.

<sup>42</sup> The ten worst performers 2008 were according to their EPI score: Niger 39, Angola 40, Sierra Leone 40, Mauritania 44, Mali 44, Burkina Faso 44, Chad 46, DR Congo 47, Yemen 50 and Guinea Bissau 50. The methodology of the EPI may owe some inspiration to the UNDP Human Development Index which also establishes absolute limits above (or below) which human development does not improve (cannot deteriorate) further. But while the HDI's limits are based on a philosophical argument regarding how old, educated, or rich you have to be in order to attain the highest possible human development, the EPI takes actual country performance as a guide to set the limits for highest/lowest scores. In case you wonder about the HDI and its conclusions: countries do not improve their scores once their average expected life time reaches 85 years, the number of school years amounts to 15, and income is 40 000 PPPdollar per capita. Thus, post-graduate studies do not lead to higher levels of human development, according to the UNDP at least.

<sup>43</sup> South Pacific Applied Geoscience Commission 2004.

and rains. The indicators are divided into subindices according to what kind of vulnerability they contribute to: climate change, exposure to natural disasters, human health aspects, agriculture and fisheries, water, desertification, and biodiversity.

But although this may sound similar to the EPI approach, the EVI refrains from weighting the components and simply calculates the average vulnerability value, going from low vulnerability, called resilience, to extreme vulnerability. Two reasons for averaging out all this diversity into one measure are given: it is easy to understand, and more complex models do not offer any advantages or increase the utility of the index.<sup>44</sup>

Of course, if the purpose of the index you construct is to be able to issue a general warning as to vulnerability, even such a coarse method may serve, as evidenced by the result of the application of the EVI methodology (see Table 3). When measuring the vulnerability of all countries, they show a normal distribution, roughly, while the vulnerability of the 47 small island development states, for whose benefit the EVI was elaborated, is as would be expected, much more serious. Half of the world's extremely vulnerable countries, measured by the EVI, are SIDS.

**Table 3. Environmental Vulnerability Index**

	<b>Resilient</b>	<b>At risk</b>	<b>Vulnerable</b>	<b>Highly vulnerable</b>	<b>Extremely vulnerable</b>
Share of all nations, %	6	18	34	26	15
Share of Small Island Development States, %	0	6	21	36	36

Source: SOPAC 2004:18

Human Appropriation of Net Primary Product. This measure attempts to estimate the share that humans appropriate of the globally available ecological resources. The point of departure is the global net primary product, NPP. From this indicator, the share that humans appropriate, called HANPP, is deducted. The remaining net primary product is then what is available for all other uses on earth.<sup>45</sup> The perspective is thus very much global, and no attempt is made to capture HANPP per capita or in relation to different national NPP, probably wisely so.

The volumes appropriated by humans are calculated from what people use directly – food, fuel, fibre, timber, and the land areas that have been required for this consumption – complemented by land areas that have been converted from biologically productiveness to other uses (cities, roads) or simply made wastelands by inappropriate or excessive use (salinization, deforestation).

The conclusion is that approximately 40 percent of the available net primary product is being appropriated by today's global population. This leads to a warning: in a business as usual scenario – that is assuming the same technology and "*current patterns of exploitation, distribution and consumption*", and taking the foreseeable population growth into account, humans will appropriate half of the net primary product, in two decades' time.<sup>46</sup>

<sup>44</sup> Op cit, p6.

<sup>45</sup> Vitousek et al 1986.

<sup>46</sup> Op cit:373, italics in original.

The significance of this share of human appropriation depends on how much the "rest of the world" needs in order to function well. No reliable estimate exists, and available guesstimates vary widely, with non-human needs set at 12 to 75 percent of the global bio-capacity.<sup>47</sup> Thus it may well be that a HANPP of 50 percent by some natural scientists may be considered to be on the safe side.

Ecological footprint analysis. Ecological footprints (EF) are similar to the HANPP in the sense that they attempt to measure "human appropriation of ecosystem products and services in terms of the amount of bioproductive land and sea area needed to supply these services."<sup>48</sup> But contrary to the HANPP, EF are expressed on a per capita basis and then compared to available areas.

Areas appropriated are calculated as the areas used for renewable resources – forests, croplands, fisheries and grazing lands – as well as the area that would be required to absorb the carbon dioxide which is "produced" when burning fossil fuels, expressed in hectares by using a hypothetical average of land productivity, a "global hectare". This procedure means that various areas are substitutable for each other. The reductionism – although not as generalized as when you assume that everything is exchangeable for everything else – is problematic, as many areas in fact cannot perform the same ecological functions. To see this, suffice it here to compare the area for fish catch with the area calculated for forestry products, and it should be clear that substitutability is a problematic assumption.<sup>49</sup>

The EF has difficulty to account for nuclear power. In the latest available version, nuclear power has been deleted from the footprint all together. The reason stated is that the way the footprint of nuclear electricity had been measured was "not scientifically sound". Before, the footprint of nuclear power had been calculated as the area that would have been needed to absorb the emissions of CO<sub>2</sub> from a similar volume of electricity produced by fossil fuels. But since actual fossil fuel electricity production units had very different efficiency levels, no reliable estimate of the relevant ecologically productive area could be calculated.<sup>50</sup>

This may be true, but if the argument for leaving out nuclear power is correct, then the whole concept of global hectares may be questioned. EF is based on a high level of abstraction, and average bio-productivity of a global hectare is no different from estimating an average CO<sub>2</sub>-footprint from fossil fuel which is theoretically calculated as substituting for nuclear power.<sup>51</sup>

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<sup>47</sup> Hoekstra 2009:1970.

<sup>48</sup> Wackernagel 2009:1925.

<sup>49</sup> Borgström Hansson 2003:167-168.

<sup>50</sup> This is the reason for deleting the nuclear power footprint that is stated by the WWF 2008. In a recent article, 29 researcher, including the originators of the ecological footprint approach, William Rees and Mathis Wackernagel, argue that "the footprint of nuclear land should not be calculated using the fossil fuel equivalent method, as this equivalency does not reflect any measurement of actual demand on the biosphere." See Kitzes et al 2009: 1999.

<sup>51</sup> WWF 2008:42-43. This is not the first time that the EF has problems with nuclear power, its inclusion in the EF was discussed already in an earlier report (WWF 2006:39), when nuclear power only accounted for 4 percent of the total global ecological footprint. For the EU as a whole, however, nuclear power is responsible for an area of half a hectare (per capita), which is equal to 10 percent of the total EU footprint. But for a nuclear dependent country like Sweden, the changed principle is welcome since it has reduced the Swedish footprint by as much as 14 percent, from 6.1 ha to 5.1 ha 2003-2005. Note that the emissions of carbon dioxide from the nuclear power plants are included in the foot print, but not an equivalent based on the electricity generated. The nuclear power industry must be pleased.

Thus the EF only accounts for part of the total human footprint, and compares this partial indicator with the total areas available without taking account of the needs of other species in terms of ecologically productive areas. This is of course no secret, but part of the claim for relevancy that the approach presents: if humankind is already overusing the available area, without calculating the needs of “competing” species, the real predicament of making human life styles “fit” within the available space is exacerbated.

In the future, the EF approach intends to include other greenhouse gases than carbon dioxide, as well as integrating a measure for the use of water.<sup>52</sup> But while calculating the footprint related to all greenhouse gases – and not just CO<sub>2</sub> – makes eminent sense, including water in the ecological footprint would be more problematic.<sup>53</sup> The basic thrust of the EF is its use of the averaged productivity, the “global hectares”, which makes the comparison of appropriated space possible over the globe irrespective of the territory a specific country commands.

But water use is best measured against local availability, not against some kind of global water supply figure. This means, it seems to me, that if you include water in the ecological footprint analysis, you will simultaneously be forced to relate the ensuing footprint to the locally available biological resources, which would transform the EF from a global measure of comparable resource use, into a national measure where resource use is compared to the nationally available resources. This, in turn, would make the EF + water footprint fit in sparsely populated countries like Sweden, Canada and Finland, where biological resources and water abound (in relation to these countries' rather small populations).

Material Flow Analysis. An attempt to measure the impact of the economy on the environment that is gaining increased currency, is material flow analysis, MFA.<sup>54</sup> In order to analyse an economy's exchanges, physical indicators expressed in tonnes are calculated for inputs, imports and exports. But it seems unlikely that by reducing environmental load to one common physical indicator – tonnes – you would arrive at a meaningful indicator of environmental load. Ought we not take into consideration the very different and varying degrees of toxicity of the materials that go into the process of social metabolism, for instance by not putting mercury on an equal footing with lime stone?

This is recognized by the MFA methodology:

"A million tons of earth moved in construction is not the same as a million tons of toxic waste."<sup>55</sup>

Hence, MFA is open to the possibility of assigning weights to different flows according to how problematic they are, "should a scientific or political consensus emerge on the relative hazards or risks associated with any particular type of material or natural resource use." But

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<sup>52</sup> Wackernagel 2009.

<sup>53</sup> Water Footprints, calculating embodied fresh water per capita, are an addition to the family of footprints (see Hoekstra 2009). But the methodology for calculating the water footprint places water used on an equal footing with evaporation, which leads to some counter-intuitive results. For instance, the water footprint of the US (2480 cubic meters per person and year) is only marginally larger than that of countries of Southern Europe (on account of the large volumes of evaporation in Greece, Italy and Spain. Similarly, Asian countries with inefficient rice production techniques score high on the water footprint ranking list.

<sup>54</sup> The literature on MFA is abundant. See e.g. Matthews 2000 and Adriaanse et al 1997. MFA may be a useful tool for analysing ecological unequal trade relations, especially in a North-South perspective, an issue that I will discuss in a later paper.

<sup>55</sup> Adriaanse et al 1997, p 6. Following quotes, op cit, p 7, and Box 1 respectively.

for the time being, the MFA procedure is defended as giving a reasonable estimate of the potential environmental impact associated with natural resource extraction and use."

Nevertheless, even proponents of this approach voice their doubt:

"we must ask whether the total weight of materials processed by a socioeconomic system is a viable indicator for 'environmental impact' at all."<sup>56</sup>

However, the authors respond to their own query in the affirmative, although not very convincingly. Assuming, they write, that technology remains fixed and does not change, then "increases in resource input imply increase in environmental impact."

But this assumption is unrealistic, and furthermore, even if it were probable that technological change would not occur, consumption patterns might change as a result of a number of things, such as the population growing older, or richer, or more environmentally informed. In the end, we are left with "'value-neutral' physical accounts that include all materials, regardless of their economic importance or environmental impact" – but not so "value-neutral" that all materials are included, freshwater flows are excluded "on the ground that they are so large".<sup>57</sup>

Still, there have been attempts to capture the "qualitative characteristics of materials flows", in order to distinguish harmful flows from harmless (or less harmful). Based on the reasoning that "materials that have been moved or are physically transformed have less potential to harm the environment", while the opposite holds true for materials that have been subjected to chemical treatment, the materials flows of the USA in 1991 has been divided into low and high potential for harm. Surprisingly, only 17 percent of the materials flows end up in the high-end category.<sup>58</sup>

There are more issues outstanding in relation to MFA. It seems to be difficult to analyze the results, high levels of material flows in the US compared to the EU, e.g., are attributed to a number of factors which seem to have equal weight:

"fundamental variations in geography, resource variability, and population density, as well as differences in lifestyle and consumer preferences (size and density of housing, recycling habits, use of individual versus public modes of transportation, etc)."<sup>59</sup>

This may explain why Finland, with a very low population density, has a higher material consumption per capita than the US, while The Netherlands end up in the opposite corner, high population density and low per capita consumption when measured by MFA.<sup>60</sup> Another explanation could be that construction mineral flows – which account for 40 percent of domestic material consumption in 14 EU countries<sup>61</sup> – and flows from forestry are dominating compared to other flows (remember water is not included). In general, MFA seems to be "favouring" densely populated countries which only depend marginally on their own bio-resources, while "punishing" sparsely populated but resource rich countries.

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<sup>56</sup> Fischer-Kowalski & Amann 2001:16. Following quote, *ibid*.

<sup>57</sup> Matthews et al 2000:2

<sup>58</sup> Adriaanse et al 1997:6.

<sup>59</sup> Rogich et al 2008:14

<sup>60</sup> *Op cit*, Fig 8

<sup>61</sup> Weisz et al 2005:34.

In conclusion, the MFA-approach seems to accept that its measure of environmental impact is a crude instrument, but it is still defended as being of the “same level of generality as overall energy consumption or population numbers” and hence acceptable as a “reasonable headline indicator for the overall scale of anthropogenic systems vis-à-vis the natural environment”. Hence, MFA is held to provide “reliable – if indirect – indicators for environmental impact”.<sup>62</sup> I doubt that, but MFA does say something about the enormous – and increasing – volumes of materials that flow around the globe, which in many cases constitute an environmental problem, if for no other reason than just because transport of bulky products and materials brings forth serious environmental consequences.<sup>63</sup>

Nevertheless, another drawback of the MFA presents itself: there is no baseline indicator against which to measure if a country's resource flow is large or small, the only possible comparison is with other countries. While this may be useful in terms of comparing efficiency and country performance, it does not provide any indication of to which extent a country is overburdening the environment, or using more than its fair share. Hence, when it comes to questions of limits as well as to matters of equity, Ecological Footprints show a better understanding of the relevant issues.

#### **4. What about non-reductionist ecological measures?**

Millennium Ecosystem Assessment. Against this background, one is tempted to discard all reductionist measures, economic as well as biophysical and social, and opt for clear cut and non-reductionist environmental measures in physical terms. One such attempt has gained widespread recognition, the Millennium Ecosystem Assessment, MA, which evaluates 24 ecosystem services (divided in three groups: provisioning services, eg. food and fiber; regulating services, eg. climate and water; and cultural services, eg. tourism and spiritual values). None of these services is valued in monetary terms, nor does the MA attempt to present an overall summary picture. The conclusion therefore is limited to the rather general statement that

“approximately 60 % (15 out of 24) of the ecosystem services examined [...] are being degraded or used unsustainably”.<sup>64</sup>

It is not easy to know what to make of the conclusion, other than that the situation seems to be quite serious. But how serious? Answering that question is not made any easier when the Millennium Ecosystem Assessment turns to discussing what it calls costs and benefits, a rare occasion for this non-reductionist approach. But as can be seen from Table 4, it is not in fact a cost/benefit analysis of the traditional kind that MA has in mind.

Table 4 looks designed to give the proactive side an advantage over the reactive, payoffs are higher and costs seem to be lower for proactive ecosystem management. My point, however, is a different one than that the presentation has been tailored to favour action over non-action.

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<sup>62</sup> Weisz et al 2005:50 This leaves out the aspect of equity once again.

<sup>63</sup> Decoupling has in fact taken place for many material flows, but invariably only in a relative sense, which means that the total, absolute, material flows have increased; cf Azar et al 2002. This is also the conclusion from a study of five countries' material flows: "materials efficiency has improved in recent decades, relative to economic growth, but [...] resource use and overall waste quantities have remained approximately steady on a per capita basis and have continued to grow in absolute terms." Matthews et al 2000:35. The countries are Austria, Germany, Japan, The Netherlands and the United States.

<sup>64</sup> MA 2005:16

This kind of qualitative discussion of "costs" and "benefits" of proactive and reactive strategies does not at all relate to the monetary, reductionist measures employed by environmental economists. Does this imply that the two approaches are unable to communicate at all?

**Table 4. Costs and benefits of proactive as contrasted with reactive ecosystem management**

	<b>Proactive Ecosystem Management</b>	<b>Reactive Ecosystem Management</b>
<b>Payoffs</b>	Benefit from lower risk of unexpected losses of ecosystem services, achieved through investment in (1) more efficient use of resources (water, energy, fertilizer, etc); (2) More innovation of green technology; (3) Capacity to absorb unexpected fluctuations in ecosystem services; (4) Adaptable management systems; (5) Ecosystems that are resilient and self-maintaining	Avoid paying for monitoring effects
	Do well under changing or novel conditions	Do well under smoothly or incrementally changing conditions
	Build natural, social and human capital	Build manufactured, social and human capital
<b>Costs</b>	Technological solutions can create new problems	Expensive unexpected events
	Costs of unsuccessful experiments	Persistent ignorance (repeating the same mistakes)
	Costs of monitoring	Lost option values
	Some short term benefits are traded for long-term benefits	Inertia of less flexible and adaptable management of infrastructure and ecosystems
		Loss of natural capital

Source: MA 2005:137.

Headline Indicators or Healthy pluralism? One solution to the problem of communication – and of clarity – is to opt for choosing a few but telling indicators, in this case ecosystem services. Although it may be difficult to distinguish the utility and importance of one ecosystem from another, headline indicators, or core sets of measures, could facilitate communication:

“The interest in H[eadline] I[ndicators] is rooted in the perception that robust core sets of measures are easier to understand, and they help track progress (or lack of it) towards selected policy goals. It also reflects an understanding that working with a long list of indicators can be counterproductive, as in all-inclusive indicator sets real priorities tend to be lost.”<sup>65</sup>

The reluctance to accept all-inclusive lists is understandable against the background that a 2005 review came up with 669 different initiatives of elaborating indicators of sustainable development.<sup>66</sup> Proponents of material flow analysis argue along similar lines. While realizing that tons may not be the most exact indicator to capture the real ecological significance, they nevertheless hold it to be

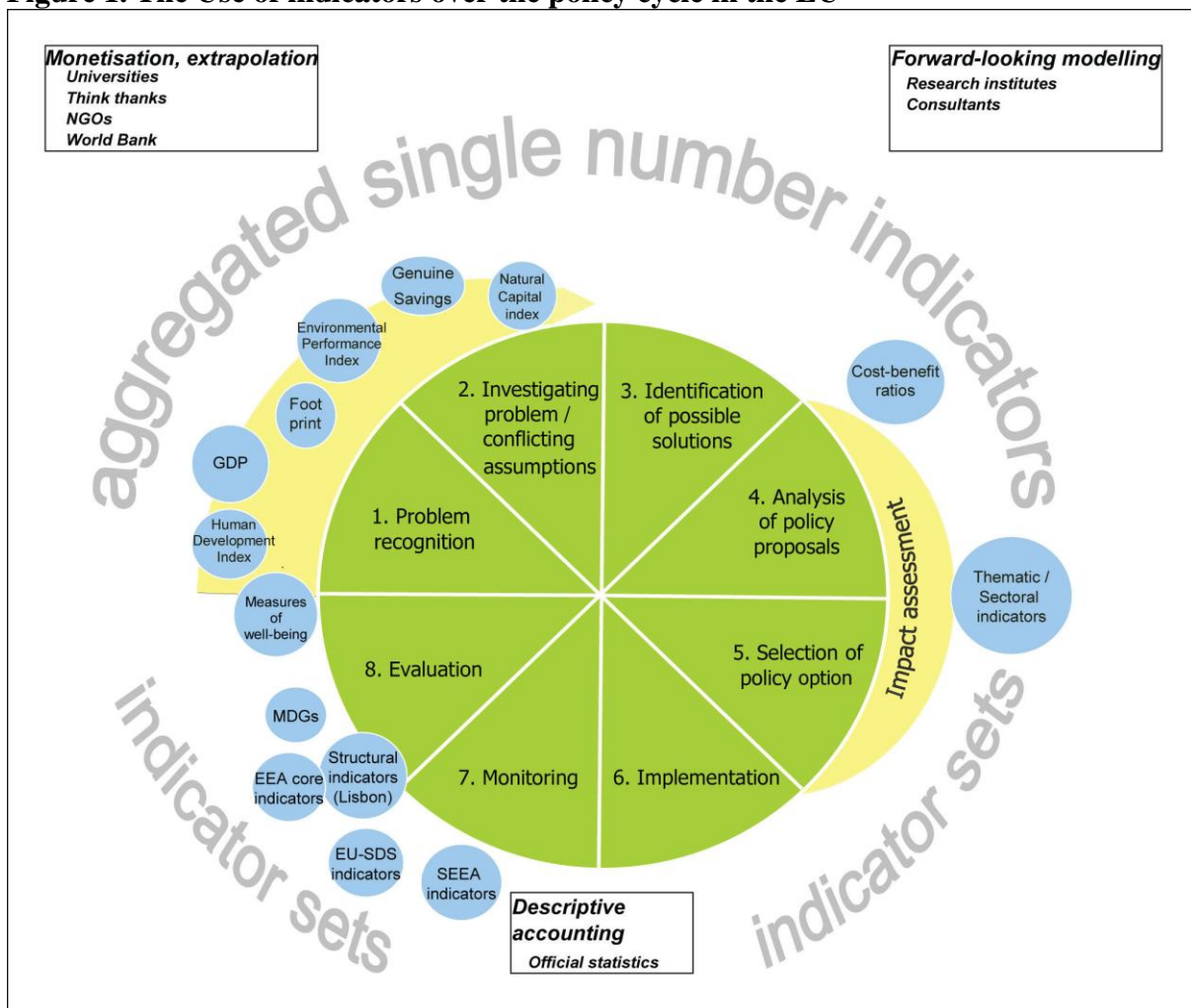
<sup>65</sup> Pintér et al 2005:7.

<sup>66</sup> Op cit, p 5. A fast rise in the number of indicators began to take place in the mid-1980's. Wesselink et al 2007:6.

"a reasonable headline indicator for the overall scale of anthropogenic systems vis-à-vis the natural environment, on the same level of generality as overall energy consumption or population numbers."<sup>67</sup>

But is really the solution to this problem – many indicators/no priority/difficulty to get the message across – to reduce the complexity to something which can be captured in a newspaper headline or a 17 seconds TV newflash? Another option would be to accept the growing number of indicators, and the different perspectives they apply, from economic to ecological, social and cultural, and assign them each a role in the process of evaluation, decision making and monitoring. This seems to be the approach chosen in the European Union "policy cycle" (see Figure 1).

**Figure 1. The Use of indicators over the policy cycle in the EU**



Source: Wesselink et al 2007: 9

There certainly appears to be a healthy pluralism here, which accepts ecological footprint analyses as well as the EPI and the Genuine Savings approach. In this way indicators and measures based on antithetical definitions of sustainability could be seen to have gained an equal footing.

<sup>67</sup> Amann et al 2002:7.

But a closer reading of Figure 1 discloses that the measures and indicators that really matter when decisions have to be made – see the right hand part of the cycle, i.e. analysis of policy proposals and selection of policies – is the traditional cost/benefit analysis where monetary reductionism rules. This becomes clear from Figure 1, when we follow the policy circle around, from problem recognition (No 1, where many indicators and procedures are applied) to policies (Nos 4 and 5) where the options have been severely limited. Thus, pluralism may sound good on paper, but when it comes to tough decisions, where win-win situations are no more and trade offs have to be made, then monetary reductionism still has the upper hand.

### 5. Can monetary reductionism be put to good use?

A claim made by adherents of monetary reductionist metrics is that although many indicators and measures are far from perfect, they nevertheless enable society to make better and more informed decisions. Let us see how this works out, by comparing two discussions based on the same monetary logic which nevertheless reach totally divergent conclusions.

Copenhagen Consensus. The Copenhagen Consensus is one of the most criticized – not to say loathed – attempts to use economic reductionist arguments to aid decision-makers when it comes to tackling global challenges, from epidemic diseases to climate change. A number of best-mind economists were asked to rank which of the challenges they thought should be dealt with first.

The ideal, we are told by the initiator of the Copenhagen Consensus, statistician Björn Lomborg, would have been if the economists had based their conclusions on cost/benefit analyses. However, the economists applied only qualitative analyses, and just listed the order in which they thought that the various problems ought to be addressed, judged by their subjective assessments of where the result per dollar spent would be largest (so called cost-efficiency).<sup>68</sup>

The outcome of their efforts can be summarized simply. In 2004 they found that priority should be given to improving health and food security, and to fighting corruption; policies addressing climate change were given the lowest priority. The same ranking was established four years later, at the 2008 Copenhagen Consensus.<sup>69</sup>

Now the question arises if this conservative outcome – social development is given priority over the environment – is caused by the method of evaluation, i.e. by framing the issues in terms of cost efficiency? I believe not. An almost identical logic, also based on costs and benefits but applied by a UNDP study, resulted in the opposite conclusion, in favour of action.<sup>70</sup>

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<sup>68</sup> Lomborg 2004:6. Lomborg did not provide the economists with a discount rate, nor with an average value of statistical life. This may have been a wise decision, since, as Lomborg recognizes, such prescriptions would have been too limiting considering the different circumstances of the challenges and the proposed solutions. Nevertheless, he threatens that future Copenhagen Consensuses may be based on such doubtful metrics.

<sup>69</sup> One of the challenges that the panel confronted in 2004 was the need for financial stability. However, the panel found that the issue was complicated and declined to discuss it further; not a very proactive attitude to take, as has become evident since. In the 2008 Copenhagen Consensus, the issue of financial stability had been scrapped altogether and was not even considered among the ten priority needs. See [www.copenhagenconsensus.com](http://www.copenhagenconsensus.com), 20090219)

<sup>70</sup> The UNDP exercise is actually not based on costs and benefits, but compares two sets of costs: costs of inaction with costs of corrective action. No discount rate is used, which can be justified by the fact that the figures are for one year, not for costs suffered over time. For a further discussion on discount rates, see below.

The UNDP considered a more restricted list of challenges – and found that in all instances the costs of inaction were much higher than the costs of mitigation (see Table 5). The conclusion is that action always is to be preferred to inaction, the costs of doing nothing are far superior to the relatively low costs of taking corrective action. But note that the principle is the same one that Copenhagen Consensus applies: action is only recommended when costs of corrective action are lower than the costs of inaction.

**Table 5. Annual costs of inaction compared to the costs of corrective action**

<b>Costs in billion of USD</b>	<b>International financial stability</b>	<b>Multilateral trade regime</b>	<b>Reducing disease burden</b>	<b>Climate stability</b>	<b>Peace and security</b>
Inaction	50	260	1 138	780	358
Corrective action	0.3	20	93	125	71

*Source:* Conceição 2003:159

In other words, it is not the logic of pitting monetary costs against monetary benefits (or avoided costs) that constitutes the problem, monetary reductionism and proactive conclusion are not mutually exclusive, it all depends on the values and assumptions that you build your argument upon. The same conclusion holds, I believe, if we – unlike the Copenhagen Consensus and the UNDP – applied traditional cost-benefit calculations.

Cost-Benefit Analyses. The conclusion reached by the UNDP – action is always to be preferred to inaction – may be welcome to those who would like to see more political action, but it does not impress environmental economists who are used to comparing and evaluating costs against benefits over time.

The discount rate applied in the analysis largely decides the outcome, especially if we consider long time periods, which is common with respect to ecological issues. For instance, the only real difference explaining the opposing conclusions reached by two leading environmental economists when calculating the economics of climate change is their choice of discount rate.<sup>71</sup> While Nicholas Stern argues in favour of strong actions now to mitigate climate change – to the tune of 1 percent of world GDP – William Nordhaus has come out strongly in favour of doing basically nothing. Their models of climate change are more or less identical, but they part ways when it comes to discount rates: low – implying valuing the future highly – in the case of Stern, and high – implying valuing the future lightly – for Nordhaus.

But is the Stern Report right in fixing the discount rate so low that it becomes practically of no importance? Yes, I believe so, the argument in the Report would actually lead to a negative discount rate: when incomes can be assumed to fall over time, discount rate should be negative, as poorer people in the future will suffer more from the effects of climate change than less poor people today.<sup>72</sup>

Furthermore, Stern argues convincingly that pure time preference – the assumed wish of people to consume today rather than postpone a bigger consumption – only is a reasonable

<sup>71</sup> Dasgupta 2008:54. While Stern used 1 percent as discount factor, Nordhaus operates with 4 percent. Dasgupta observes that this means that Nordhaus is valuing future losses seventeen times less than Stern.

<sup>72</sup> Stern 2006:36-37.

assumption for people "who care little about future generations" – which by implication also means that they care little about climate change.<sup>73</sup> Hence, assuming time preference as a reason for establishing a (high) positive discount rate, precludes the outcome of the investigation: people who value the present higher than the future, and who put the fulfilment of their own needs above the fulfilment of the needs of their children and grand children, may safely be assumed to disregard future climate change as well.

Nevertheless, the approach of the Stern Report is not easily accepted, as is clear from a UNDP briefing paper.<sup>74</sup> Here the claim is that two considerations enter into contradiction with each other. On the one hand, if we value the needs of future generations as high as we value our own, the discount rate should be low. But on the other hand, future generations are likely to be richer, which would lead us to increase the rate (since the welfare of the present generation would be more affected by the loss of one dollar than that of future generations). But isn't it more reasonable to assume that these considerations in fact operate so as to reinforce each other, future generations will be worse off than the present one, at least when it comes to ecological resources?

This is indeed how the Stern Review argues, and accepting this position will lead us to use a discount rate that is negative, in recognition of the argument that future generations, poorer than the present one, will be harder struck if we postpone the remedial action.<sup>75</sup> Intergenerational justice simply prescribes more action today.

There is also yet another way to make use of monetary reductionism, by accepting the forecasting of growth rates into the distant future. This enables us to estimate the costs of corrective policies, which will appear small compared to the assumed future riches that unlimited growth will offer. Based on this logic, global economic growth will have multiplied the earth's GDP tenfold by the year 2100. Policies to reduce climate gases would mean a cost in terms of economic growth foregone, but they would only postpone reaching the same level of economic wealth by two years. Hence, the earth would be ten times richer – with greater chances of climate stability – 2102 instead of 2100.<sup>76</sup> Again, it is not the monetary logic as such that precludes pro-action conclusions.<sup>77</sup>

Summers' World Bank memo. In December 1991, a memo was leaked from the World Bank, signed by the then chief economist Lawrence Summers, arguing for transferring polluting industries and toxic waste to poor countries. The argument, Summers wrote, was based on "economic logic" and was "impeccable".<sup>78</sup> He gave three reasons:

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<sup>73</sup> Op cit, p 54.

<sup>74</sup> Conceição et al 2007.

<sup>75</sup> Dasgupta 2008:53. Perhaps a religious world-view, as expressed by Daly & Cobb 1989:239 is worth listening to: "As far as we know God is not impatient for all lives to be lived soon. We believe the divine discount rate is zero."

<sup>76</sup> Azar & Schneider 2002:77.

<sup>77</sup> Nevertheless, it has been argued that the economic logic of cost-benefit analyses is more of a problem than an aid in discussing climate change, as what the Stern Review concludes in fact only amounts to a recommendation that the world would be "in the distant future [...] only much, much better off than the present instead of being much, much, much better off. That is too bad, but it is not really a tragedy." (Neumayer 2007:300). Hence, it is argued that leaving economic arguments altogether to the side would be preferable, at least as long as they are based on assumptions of substitutability.

<sup>78</sup> The memo was sent by Summers but is rumoured to have been drafted by his staff member at the World Bank Lant Pritchett (subsequently a member of the Copenhagen Consensus). For the memo, see [www.globalpolicy.org/socoecon/bwi-wto/summers99.htm](http://www.globalpolicy.org/socoecon/bwi-wto/summers99.htm). Summers' career was not particularly hurt by the memo: after leaving the World Bank – his successor was Joseph Stiglitz – he became deputy secretary, and then

- “a given amount of health impairing pollution should be done in the country with the lowest cost, which will be the country with the lowest wages”.
- “The costs of pollution are likely to be non-linear as the initial increments of pollution probably have very low cost”.
- “The demand for a clean environment for aesthetic and health reasons is likely to have very high income elasticity.”

Such arguments can be analyzed with different perspectives. Is Summers cynical, or only clear-sighted? Was he serious, or was the memo a joke, or perhaps a warning to the World Bank that it was carrying its neo-liberal agenda too far?<sup>79</sup>

David Harvey chooses to take it seriously, and sees Summers' reasoning as “class situated”, Summers is in fact in favour of dumping the wastes of the rich on the poor.<sup>80</sup> This is, however, evident, it is the stated purpose of the memo, but the interesting part is what arguments Summers musters in order to make his point. But Harvey is not interested in discussing on Summers' terms, and maintains that prevention ought to take precedent over disposal, which sounds nice but does not constitute an objection to Summers' line of reasoning. Economists who argue like Summers are not opposed to prevention as such – but they only accept it if the economic cost is lower than the cost to take care of the subsequent waste. Hence, to argue that Summers should accept that prevention is to be preferred to disposal is in fact begging *his* question.

Underlying Summers' logic, Harvey finds the “political economy of waste creation and circulation under capitalism”<sup>81</sup> which ought to stop us from accepting to manage the impact of the economy on nature. Of course, if every argument and policy is measured against the need of “challenging the capitalist economic system head on”<sup>82</sup>, then not only Summers but most if not all arguments for reducing the environmental load of the existing economic system would be ill advised.

There is, however, more to learn from Summers' memo than this. He calculates costs of pollution by using the value of individuals as measured by average GDP. This is akin to what many cost-benefit analyses do, and thus commits the same error, valuing human lives in terms of their income. This is no inconsequential procedure, as can be seen from an attempt to estimate which countries cause environmental damages, and which suffer from them (See Table 6).

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secretary of the treasury with the Clinton administration. Following this, he was chairman of the board of Harvard University, and is presently chief economic advisor of President Obama.

<sup>79</sup> A part of the memo that is seldom quoted – one exception being David Harvey, see below – strengthens the possibility that Summers is in fact making fun of the World Bank. Summers' memo continues: “The problem with the arguments against all of these proposals for more pollution in LDCs [least developed countries] (intrinsic rights to certain goods, moral reasons, social concerns, lack of adequate markets, etc) could be turned around and used more or less effectively against every Bank proposal for liberalization.” For the memo, see [www.globalpolicy.org/socecon/bwi-wto/sumers99.htm](http://www.globalpolicy.org/socecon/bwi-wto/sumers99.htm). Summers' career was not particularly hurt by the memo: after leaving the World Bank – his successor was Joseph Stiglitz – he became deputy secretary, and then secretary of the treasury with the Clinton administration. Following this, he was chairman of the board of Harvard University, and is presently chief economic advisor of President Obama.

<sup>80</sup> Harvey 1996:367.

<sup>81</sup> Op cit, p 369.

<sup>82</sup> Op cit p 382.

When people's lives are valued according to their income, the unequal distribution of damages suffered should be obvious from Table 6: low income countries get the same share of damages suffered as high income countries, although the latter country grouping has caused more of the damages in the first place.

**Table 6. Environmental damages suffered 1960-2100 according to country income**

	<b>Low income countries</b>	<b>Middle income countries</b>	<b>High income countries</b>
Share of damages suffered, %	20	60	20
Share of damages suffered when human lives are equally valued, %	44	53	3

*Source:* Based on Srinivasan et al 2008. The environmental damages considered are climate change, ozone-layer depletion, agricultural intensification and expansion, deforestation, overfishing, and mangrove loss. Country groupings according to the World Bank.

The time periods contemplated are for climate change 2000-2100, for ozone layer 1985-2100, and 1961-2000 for the remaining damages. Discount rate 2 percent. The monetary values are expressed in purchasing power adjusted dollars (PPP), which partly counters the differences among country groupings on account of different income levels.

Still this unequal distribution becomes much more severe when human lives are equally valued: the burden of the poorest group of countries more than doubles, while the richest countries see their suffering dwindling.

Similar mistakes when operationalizing a monetary reductionist approach are frequent when using cost-benefit analyses. When people affected by environmental degradation are asked about their willingness to pay to get rid of a problem affecting them (or the sums they would require to accept it), environmental economists usually confounds *willingness* to pay with *capacity* to pay.<sup>83</sup> Furthermore, such value assumptions collide head on with rights based approaches where human beings are considered to have intrinsic and equal value (as Summers himself recognized).

Summers' second point is based on non-linear increases of costs of pollution, which may very well be a reasonable assumption<sup>84</sup>, which leads him to suggest that waste should be dumped on poor (not yet polluted) countries, because there the damage would be less. But Summers' concern here is with distributing (i.e. spreading) a given environmental load in as efficient a manner as possible. But what if the real issue is not efficiency – although that also is an issue, just not *the* issue – but how to reduce the environmental load as such? Summers doesn't even pose the question, let alone does he provide an answer.

So, Summers argues for a cost-efficient allocation of waste over space, but does not seem preoccupied at all by the scale of the problem, hence nicely illustrating one of Daly's main

<sup>83</sup> Azar 1999:25 quotes the economist Fankhauser regarding the fact that cost-benefit-calculations of the effects of climate change seem to imply that the value of a Chinese life is less than that of a European. No, says Fankhauser, "it merely reflects that the willingness to pay for increased safety (lower mortality rates) is higher in developed countries." Fankhauser lets capacity stand for willingness to pay.

<sup>84</sup> Perhaps I should add that even better – in the sense of better reflecting reality – is to assume not only non-linear increases, but also to assume the existence of thresholds and of non-predictable cost curves. This would lead us into a totally different discussion of thresholds and unpredictable costs of increasing environmental loads, which in turn would call for an operationalization of the precautionary principle.

points: environmental economists have not realized that the crucial issue is the scale of the economy vis-à-vis nature.<sup>85</sup>

But what about Summers' third point which in non-technical language reads that only rich people care about the environment? This is a pet idea of environmental economists arguing that economic growth is actually a boon to the environment: as people get rich(er), they will care more, and, hence, they will be prepared to pay more (or sacrifice more, or abstain more) for the environmental services they now value higher.<sup>86</sup> A win-win situation, in other words. Suffice it here to say, that this argument has been refuted over and over again, on moral as well as on factual grounds, but it keeps coming back as a favourite assumption of economists.<sup>87</sup>

## 6. Where could we go from here?

How may sustainable development, in the strong sense, be encouraged? Let me return to the question I posed at the beginning of the previous section: Can monetary reductionist measures be put to good use?

Yes, as we have seen, even reductionist metrics and procedures may lead to positive, pro-active conclusions. The outcome and the conclusions arrived at hinge on the assumptions, values and figures that go into the calculus. Nevertheless, I believe that the weak and

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<sup>85</sup> Daly recounts a discussion he had with Summers while they both were staff members of the World Bank. When asked by Daly "What is the optimal scale of the macro economy relative to the environment?", Summers replied: "That is not the right way to look at it." (Daly 1996:6).

<sup>86</sup> This argument is also part of Harvey's (1996:380) explanation why ecological concerns have come to be seen as important by (some) people in the North: "The rising tide of affluence in the advanced capitalist countries after World War II increased middle-class interest in environmental qualities and amenities, 'nature' tourism, and deepened concerns about environmental dangers to health."

Basically, Harvey mobilises class and people's needs against nature and eco-systems; this is the thrust of his argument (p 400): "The demand [by environmentalists] to cease the production of all toxins, hazardous wastes, and radioactive materials, if taken literally, would prove disastrous to the public health and well-being of the large segments of the population, including the poor [...] And the right to be free of ecological destruction is posed so strongly that it appears to preclude the positive right to transform the earth in ways conducive to the well-being of the poor, the marginalized and the oppressed."

I read such statements as reflecting an anthropocentric system of values which poses social and human needs against those of the environment; the former are always given priority at the expense of the latter. The bottom line is surprisingly similar to the one of the Copenhagen Consensus.

On the other hand, Hornborg 2001:52-53, after approvingly noticing Harvey's class consciousness when it comes to realizing who is hit by ecological degradation and pollution, voices an objection relating to Harvey's inability, "like other Marxists", to combine his critique of capital accumulation with a "questioning of the *machine*, its material form". Hornborg finds the origin of this limitation in Harvey's argument in the fact that Harvey has not developed a new understanding of technology, which ought to be seen as a zero-sum game where the machine is an institution that redistributes time and space world wide, an understanding that we need in order to be able to elaborate a theory of global environmental (in)justice. But couldn't Harvey's position equally be explained as a refusal to give up an essentially positive stance when it comes to technical development, i.e. an embrace of the very modernization he criticizes so fiercely? The critique of its ecological costs arises only because they unjustly fall upon the poor. Which in turn may lead to a stance where the ecological costs only constitute a temporary drawback of development that later will be resolved, new class relations permitting, by yet further technical progress.

<sup>87</sup> There is also a legal aspect to the Summers' memo. The Basel Convention, which was adopted in 1989 (and which entered in force in 1992, after the memo was written) prohibits exports of hazardous wastes unless there is guarantee for appropriate handling at the place of destination. The convention is not a very strong set of rules, and an amendment banning the shipment of hazardous wastes from rich (EU and OECD-countries) to poor countries, signed in 1995 has not entered into force. Neither the convention, nor the ban amendment has been ratified by the United States. See [www.basel.int](http://www.basel.int).

reductionist approach of environmental economists is of little help but rather tends to hide the real tradeoffs economic growth – strong sustainability.

Here is an example. Heal complains that Stalinist (sic!) policies have dominated the environmental political sphere as government agencies

“have relied on telling people exactly what to do and what not to do. They have been classic command and control policies.”<sup>88</sup>

Instead Heal recommends us to think like “an enlightened economist” when it comes to safeguarding biological diversity: the state ought to pay land owners for the protection of species:

“The more endangered animals you have on your land, the more the Fish and Wildlife Service pays you. If the payment were high enough, there would be an incentive to encourage and assist the endangered species.”<sup>89</sup>

And if not? Even environmental economists, who recognize the utility of economic incentives in changing the behaviour of individuals and firms, are reluctant to trust the economic calculus suggested by Heal when there exists a danger of irreversible change (which is the case of extinction of species). The reason is simple: if the pay isn’t high enough, or if other uses of the land give a higher financial return, species would go extinct.

But environmental economists of the kind that Heal represents are not to be deterred. They use simplified arguments in favour of private ownership of public goods, like this one:

“When one views desertification in China, water contamination in Senegal and forest depletion in Haiti, it is hard to imagine that the establishment of property rights or improved pricing of natural resources could worsen the prospects of future generations.”<sup>90</sup>

For the rest of us, we are well advised to consider the appropriate combination of different metrics for the economy-nature interface. There is a by now familiar argument, that although reductionist measures may not be perfect, they will not make things worse. Also Daly in his defence of the monetary measurement of ecosystem services, says:

“for those who only hear dollars, let us scream now and then in dollars!”<sup>91</sup>

The problem, however, is that if you accept the logic of talking money to people who only understand this metric, you may be caught in the same monetarist reductionist logic yourself. A case in point: the Swedish ministry of the environment had meteorologist Arne Jernelöv design an indicator of Sweden’s environmental debt. The debt was defined as the costs of restoring nature and re-establishing ecosystems that had been hurt. However, in all the cases

<sup>88</sup> Heal 2007:19. He attributes the curse word – Stalinist – to the economist Robert Solow and finds it “absolutely correct”.

<sup>89</sup> Op cit, p 20.

<sup>90</sup> Arrow et al 2004:169. China has a dual role for this group of environmentalists; in one and the same article it is an example of the worst possible cases, as in this quote; but it is also an example, three pages earlier (see footnote 38 above), of a sustainable path since its investments in education and in the economy are so high! China – a sustainable desert!

<sup>91</sup> Daly 1998:23.

where restoring was seen to be impossible on account of irreversible change, no price was allocated. The logic of the then minister of the environment who had commissioned the work, Olof Johansson:

“Everything valuable has a price.”<sup>92</sup>

In other words, irreversible change implies no loss of value as it carries no price tag. This is where we have to part ways with the monetary metrics, it cannot tell us what value is, nor what ought to be done to assure sustainability in the strong sense. Monetary indicators, to put it mildly, are not the whole answer, not even to those who otherwise have argued that we need them to be able to influence political decisions and processes:

“Many would question whether monetary valuation alone adequately captures what decision makers need to know to confront irreversible ecosystem modifications that could have serious long-term economic and social repercussions. Perhaps the most important task is to clarify where conventional economic values are sufficient for decisions and where broader human values – including non-monetary values – and criteria for decision making are more appropriate.”<sup>93</sup>

Once the issue at hand has aspects of irreversible change, or long-term consequences that are felt over extended periods of time, or high degrees of uncertainty as to the impact of a given course of action, or to the distance to thresholds and unforeseeable processes of change, non-reductionist approaches are to be preferred.

Thus we must define limits, levels of acceptable environmental pressure, veto thresholds,<sup>94</sup> or safe minimum standards.<sup>95</sup> Here, monetary indicators are next to useless, but so are reductionist physical indicators, the level of aggregation is too high, they try to lump together too disparate measures and indicators which taken one by one, however, would be of great use. Thus, “border values” cannot be expressed in reductionist terms, neither monetary nor physical.<sup>96</sup>

This conclusion goes against the grain of one of the leading trends in environmental economics, assigning monetary value to environmental services. For instance, one way to value degradation is to set it equal to the costs of conservation, which makes sense only if you base your argument on the assumption that all environmental degradation is reversible, i.e. that damages may be rectified over time.<sup>97</sup> But this would shut out the opposite assumption that many processes are irreversible (e.g. extinction of species). In other words, “price tagging” may be built on quite unrealistic assumptions.

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<sup>92</sup> SOU 1992:4.

<sup>93</sup> Bingham et al 1995:75.

<sup>94</sup> Martinez-Alier et al 1998:284.

<sup>95</sup> IUCN et al 2004:29.

<sup>96</sup> However, Goodland & Daly use the concept of “critical level” to argue that “it is difficult if not impossible to define critical levels of each type of capital, or rather each type of natural capital that is the limiting factor.” (Goodland & Daly 1996:1006). Hence, they claim that it may be too much to decide when substitutability between natural and man-made capital is a reasonable assumption, and when it should be abandoned as natural capital is needed for the ecosystem as a whole to function. But my point here is rather that we should attempt to establish thresholds for the different resource categories independently of each other, a recommendation that also applies to different forms of natural resources, not only natural vis-à-vis man-made resources.

<sup>97</sup> Gerlagh et al 2002: 158.

But we may go one step further, by realizing that the strong sustainability definition implies that the economy must fit within the limits established by nature. As a consequence, we may identify the essential ecological systems that have to be safe-guarded, and that hence cannot be allowed to be destroyed, irrespective of what happens in other spheres of reality (society, economy, outer space...).

Such systems, then, must be measured by biophysical indicators and not allowed to be integrated into weak sustainability indicators, irrespective of whether they use monetary or physical measures of performance. It is in the first place in relation to such ecological systems and services that “veto thresholds” and lower bounds should be applied. One list of such essentials can be taken from the 24 ecosystem services analysed by the Millennium Ecosystems Assessment. As pointed out, these life supporting systems are neither substitutable for each other, nor for services or goods provided by the economy.<sup>98</sup>

Monetary aspects are not to be discarded totally, however, but their role will be more linked to choosing among the different policy tools available in order to achieve a given set of objectives, based on the requirements of the various ecosystems. Thus monetary metrics will have to be refocused, from asking what should be achieved", to how to do what physical metrics will have shown needs to be done.

Finally, a perhaps reassuring thought. The power of monetary reductionism is not as all pervasive as you may think (or fear). Many socially good and necessary decisions have been taken and essential policies instigated without recourse to cost-benefit calculations, just simply because the problems at hand required action. For instance, reducing urban diseases in big agglomerations through supplying purified water, or combating air pollution in order to reduce pulmonary diseases.<sup>99</sup> Something similar can happen when it comes to the economy-nature interface.

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<sup>98</sup> Victor et al 1998 provide a much shorter, and rather confusing, list, where they mix minerals with water, and energy with biological diversity.

<sup>99</sup> Vatn & Bromley 1994:72-73.

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