universität wien

DIPLOMARBEIT

Titel der Diplomarbeit

Environmental and Ecological Economics: Two approaches in dealing with economy-environment interrelations and the example of the Economics of Land Degradation Initiative

verfasst von

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angestrebter akademischer Grad

Magistra (Mag.)

Wien, 2014

Studienkennzahl lt. Studienblatt:	A 057 390
Studienrichtung lt. Studienblatt:	Individuelles Diplomstudium Internationale Entwicklung
Betreuer:	Assistant Professor. Dr. Simron Jit Singh

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List of Acronyms:

AERE	Association of Environmental and Resource Economists
BAU	Business As Usual
CAC	Command and Control
CBA	Cost-Benefit Assessment
CEA	Cost Efficiency Assessment
CVM	Contingent Valuations Methods
DE	Domestic Extraction
DME	Domestic Material Extraction
DMI	Direct Material Input
DMC	Domestic Material Consumption
EAERE	Environmental and Resource Economics
EF	Ecological Footprint
EKC	Environmental Kuznets' Curve
ELD	Economics of Land Degradation
ESEE	European Society for Ecological Economics
GDP	Gross Domestic Production
GER	Green Economy Report
GHG	Greenhouse gases
GGND	Global Green New Deal
GNH	Gross National Happiness
GPI	Genuine Progress Indicator
GSI	Genuine Savings Indicator
HANPP	Human Appropriation of Net Primary Production
HDI	Human Development Index
IMF	International Monetary Fund
IO	Input-Output
IRP	International Resource Panel
ISEE	International Society for Ecological Economics
ISEW	Index of Sustainable Economic Welfare
JEEM	Journal of Environmental Economics and Management
KC	Kuznets' Curve
LCA	Life-Cycle Assessment
MBI	Market Based Instruments
MCA	Multi-criteria Assessment
MDG	Millennium Development Goals
MEA	Millennium Ecosystem Assessment

MEFA	Material and Energy Flow Analysis
MES	Markets for Ecosystem Services
MEW	Measure of Economic Welfare
NNP	Net National Production
NPP	Net Primary Production
OECD	Organisation for Economic Co-operation and Development
PTB	Physical Trade Balance
PES	Payments for Ecosystem Services
PPP	Polluter Pays Principle
REDD/REDD+	Reducing Emissions from Deforestation and Degradation
REF	Resource for the Future
SEEA	System of Environmental and Economic Accounts
SMCE	Social Multi-criteria Evaluation
SNA	System of National Accounts
SNI	Sustainable National Income
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
TFP	Total Factor Productivity
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Program
WCED	World Commission on Environment and Development
WTA	Willingness to Accept
WTP	Willingness to Pay

1. Introduction

Nowadays it is acknowledged that humanity massively influences the environment in a negative manner, which is why some say that we are in the Anthropocene era (Rockström et. al 2009, Steffen et. al 2011, Caldwell 1996:27, Global Footprint[3]). Human actions lead to the deterioration and destruction of the ecosystem. Rising awareness of these negative effects of human actions has resulted in great national and international endeavors to tackle environmental pollution and degradation (Caldwell 1996). In addition to environmental movements, economics also offers different approaches to minimize humans' negative actions and impacts. This diploma thesis deals with two different economic schools of thought and the way these schools integrate the natural environment into their theory. On the following pages I will provide a comparison of *Environmental* and *Ecological Economics*: the former promotes economic growth and is based on the market mechanism. In contrast, the latter emphasizes the limits to growth determined by the limits of the environment's capacities. Although in scientific literature the differences between the two seem to be quite clear, in practice this is not the case. Therefore the aim of this thesis is to discuss both schools of thought and their features and key characteristics, carving out their similarities and differences.

Literature research led me to conclude that both schools of thought do not have much in common and that their underlying concepts are completely divergent from each other. Thus cooperation between representatives of the respective schools of thought must be impossible or at least extremely difficult. This hypothesis is tested in the second part of this thesis, which is the empirical part. The second part examines the *Economics of Land Degradation* (ELD) initiative based on a literature review and expert interviews. Through the interviews I categorized the respondents as either environmental or ecological economists, in order to find out how many representatives of each school of thought are contributing to the initiative. Moreover, the interviews and the subsequent analysis helped to again find differences and similarities in respondent's perceptions and to find out on which basis they can collaborate.

As I became familiar with the topic of my thesis I often wondered if it is a good idea for a non-economist to write about an entirely economic issue. The more my research proceeded, the more convinced I became that non-economists should deal with economic issues. Reading Herman E. Daly (1996:175) and his presentation of Frederick Soddy's work on economics and thermodynamics support my belief that also non-economists can contribute significant insights. Venkatachalam (2007:552) commented on the neoliberal economists' imperialism, occupying other scientific disciplines, proliferating their one-dimensional preanalytic vision. This can be regarded as an argument for representatives of other scientific disciplines not allowing the continuing

appropriation and bringing in yet more pluralism, which probably provides a better or at least a more diverse understanding of reality. In this respect I, as a non-economist, want to enrich the theory through my preanalytic vision, which is the basis of my perceptions.

Furthermore, the importance of an interdisciplinary lens is often mentioned and even emphasized in the discourse (see Aldy / Krupnick 2009:1). For example, at the *United Nations Convention to Combat Desertification* (UNCCD) second scientific conference, which I attended, about *Economic assessment of desertification, sustainable land management and resilience of arid, semi-arid and dry sub-humid areas*, several speakers and panelists urged for an interdisciplinary approach (see UNCCD 2013, UNCCD[1], Low, P.S. 2013, Poulsen, Lene 2013). Through my studies I assimilated interdisciplinarity, connecting insights from different fields. Thus I am not only able to work in an interdisciplinary surrounding, I am interdisciplinary myself. These are just some reasons why a non-economist should deal with an economic topic.

I chose to write about an economic topic not only for the above stated reasons, but also because of my own deep interest in this field. Throughout my studies economics always accompanied me. All topics had an economic aspect; hence economy is influencing, probably even determining, every sphere of human life. Accordingly, the economy is interrelated with present environmental problems. Some even blame the economic system for being the very cause of present environmental problems. Whether or not one agrees with this assessment, economists believe that the economic system can handle and solve these problems. One thing is clear: the economy is a major influential power, positive as well as negative, and if one wants to understand present day problems and contribute to their resolution, I believe that comprehending the economy is essential. It is exactly this great influence of economy on every part of human life that requires scientists from all kinds of fields as well as non-experts to deal with the economy, to understand its importance and its functioning.

In trying to break the economists' domination, in creating the rules of life and hence shaping everyone’s life, I am indeed aware of another important issue concerning domination: gender neutrality. In this thesis, even if not especially marked, I am addressing all gender identities. However for the sake of simplicity and readability, I will not indicate all gender identities, and rather use the *male* form.

As already illustrated above, the thesis is structured in two parts. Part one deals with the theoretical comparison and analysis of *Environmental* and *Ecological Economics.* I tried to find similarities and differences concerning considerations and integration of the natural environment

into the respective theory. I decided to discuss both schools of thought in one part instead of having two separate parts that are each dedicated to one of the schools. Hence every topic is analyzed from both perspectives in order to allow the reader direct comparison. How both schools of thought can influence real policy is illustrated in a section about *United Nations Environment Program's* (UNEP) Green Economy concept. Finally, the findings are synthesized at the end of part I.

After the concluding section, the second part of the thesis starts. This part is dedicated to the more practical application of the theory. Following the differences between the two concepts, I conducted expert interviews in order to find out if the interviewees favor one of the two concepts. This information is then used to analyze the theoretical base of the ELD initiative. The aim is to find out whether one of the two schools of thought predominates or if they are represented equally. This will probably have effects on the theoretical and hence practical orientation of the initiative.

1.2. Methods

For the theoretical analysis and comparison of the two concepts I relied on literature review. To get a general insight I used two textbooks, one on *Ecological Economics* and one on *Environmental Economics*. Both are recent works, although the textbook on *Environmental Economics* is an extended sequel of the German version from 2002. Another very influential book was Daly's *Beyond Growth*, which can be seen as a stepping stone for the development of *Ecological Economics*, revealing some differences between orthodox neoclassical economics and steady state economics (Bergh 2001:14). Apart from these books the analysis is based on peer-reviewed journal articles. There are already some papers and books that deal with the differences and similarities between *Environmental Economics* and *Ecological Economics*. Some points are stated by all of them; other arguments are raised less often and with more or less emphasis. Based on these articles and books I tried to filter differences and similarities through the identification of certain keywords or concepts, like sustainability, economic growth, allocation or scale. This diploma thesis only provides a superficial analysis, since one could investigate much more deeply on many issues that differ among the two concepts. However, due to spatial and time constraints, the analysis will not go too much into detail. There is already a plethora of literature concentrating on more concrete issues. Nevertheless, it is necessary to illustrate the differences and similarities of both concepts, since much confusion and lack of clarity on how to distinguish them seems to prevail.

The second part of this thesis deals with the ELD initiative, which is again analyzed through literature review. Moreover, I conducted expert interviews with nine key contributors to that

initiative. My interest in ELD was ignited while participating[1] in the second ELD meeting in Brussels in 2012. At that time the initiative was still very young and I had the chance to get insights into the working process. Apart from this I could meet those people who influenced the initiative from the very beginning. There the idea was born to analyze ELD's conceptual basis. After checking whether ELD delivers a good case to study I started to choose my interview partners. Through my participation in the second ELD meeting I had access to background information, like who joined the first meeting and who the working group leaders were. In order to follow up the process of ELD I also participated in *United Nations Convention to Combat Desertification*'s (UNCCD) second scientific conference, held in Bonn in 2013. The conference program revealed which of the ELD contributors also contributed to the conference. Attending the meeting not only allowed me to follow ELD's progress, but also to keep in touch with my potential interview partners and to contact them again face to face. I decided to choose the interview partners according to their importance for or influence on ELD. Hence I filtered out those who participated in at least the two ELD meetings or in one ELD meeting and the UNCCD conference, or who participated in one ELD meeting and who were working group leaders. This approach provided me several potential interview partners, all of whom I contacted via e-mail informing them about my plans and asking them for their participation. I contacted those who answered and who participated in the UNCCD conference face to face, in order to introduce myself once again and to provide the opportunity to build up trust. Finally, I had a list of 11 interviewees who declared their willingness to contribute to my thesis as well as their consent regarding the terms of the interview and its usage. However, due to time constraints I only managed to interview 9 of those 11.

Via e-mail I informed the interviewees again how the interview setting would be, how long it was scheduled to take and how the information would be used. Anonymity was assured in order to allow respondents to speak frankly. Interviews were conducted via *Skype* ©, and the conversations were recorded and transcribed for analysis. The interview was semi-structured, employing open-ended as well as concrete questions. The questions were based on the differences that I could investigate through my literature research, revealed in part I of this thesis. The interviewees had no access to the questions before the interview took place, so they could not prepare their answers. Moreover, I did not disclose that I was analyzing whether they were environmental or economical economists, but rather told them that I was analyzing ELD's conceptual basis. I did not disclose the exact purpose of the interview, since I was afraid that this would negatively influence the outcome of the interviews. Hence I tried to prevent interview partners from categorizing themselves.

As stated, the interviews were recorded and transcribed afterwards for analysis. In order to do that,

1 I participated representing my supervisor.

for each question and sub-question, all answers were assembled. From this step onward names were substituted by numbers, with the numbers not following the sequence in which the interviews were conducted. Then I tried to find similarities and differences in the statements. These clusters of differences and similarities helped me in a second step to allot them to one of the two schools of thought.

I faced several problems while doing the literature review as well as the interviews. Accessing information was not a problem, but understanding specialist literature on economics was. I have to point out that generally *Ecological Economics* literature is written in an understandable way; in contrast, economic literature, which focuses on special issues, was often hard to understand, as it demands a certain level of previous knowledge. The main difficulty for me arose when text was substituted by formulas, which are not explained. Concerning the interview, the major problem was that this was the first time that I conducted interviews, so I had no hands-on experience and had to start from the very beginning. In order to get some experience before the actual interviews took place I tested the questionnaire and the technological devices used (computer, *Skype* © and recording program) on colleagues.

Part I

2. Intellectual genealogy of Environmental and Ecological Economics

As a first step I will expand on the intellectual genealogy of both schools of thought in order to show their roots. Analyzing where both schools of thought come from reveals why the respective schools and concepts developed. Throughout this thesis first *Environmental* and then *Ecological Economics* will be discussed. Instead of having two parts discussing *Environmental* and *Ecological Economics* separately, each topic is discussed from both sides in part I. This is in order to allow the reader a direct comparison.

2.1. Intellectual genealogy of Environmental Economics

Pearce (2002:57) traces the emergence of *Environmental Economics* to the 1950s, when the independent research institute *Resource for the Future* (REF) was established in the US, dealing with the application of economics to environmental issues. The reason for dealing with environmental issues at that time was resource shortage (Pearce 2002:58). *Environmental Economics* became further institutionalized through the *Association of Environmental and Resource Economists* (AERE) in the mid-1970s, with its *Journal of Environmental Economics and Management* (JEEM) (Borgström Hansson 2003:67f.).

Environmental Economics experienced its breakthrough in the 1960s (Pearce 2002:58, Asafu-Adjaye 2005:3) through works on resource scarcity but also on pollution caused by agrochemicals. Pearce argues that especially Rachel Carson's *Silent Spring* influenced the evolution of *Environmental Economics*. Her work dealing with agriculture is of interest for economics generally, since through agrochemicals huge profits are realized and agricultural production has increased substantially. Additionally, certain concepts of *Environmental Economics* were already developed within mainstream economics before the 1950s.

Economists who provided underlying principles and concepts were Pigou, Coase, Dupuit, Hicks, Kaldor and Hardin (Pearce 2002:58f., Pearce et al. 2006:32, 58, Hamilton / Lutz 1996:2, Borgström Hansson 2003:69), some of which will be mentioned below. Concepts of costs and benefits of economic action were understood, and Pigou came up with the idea of environmental taxes, an idea which was later picked up by Coase, who wanted to solve the environmental problems through the market mechanism only. From that time onward more and more methods were developed in order to reduce environmental degradation (Borgström Hansson 2003:69f.).

However, it is difficult to clearly state a date which marks the beginning of the independent school of thought of *Environmental Economics*. Borgström Hansson (2003:67) points to Allen Kneese as

one of the early intellectual fathers of *Environmental Economics*. One major method which was key for the development of *Environmental Economics* was monetary valuation, which allowed the employment of Cost-Benefit Analysis (CBA) to promote the decision-making process. Moreover, Borgström-Hansson (2003:71f.) indicates that after promoting a neoliberal economic policy, which involves minimizing the role of the government in economic regulation, a shift was needed to make government intervention again acceptable. CBA illustrated that intervention helps to increase benefits and lower costs. Thus CBA was the tool which offered the basis to legitimate governmental intervention.

Natural Resource Economics also evolved in the 20th century, dealing with optimal resource use. In contrast *Environmental Economics* mainly deals with pollution. This distinction is, however, not made any more, since the concepts enrich each other (Pearce 2002:59). Within this thesis the concept of *Natural Resource Economics* will not be discussed further. Another concept originating in the 20th century is *Ecological Economics* (Pearce 2002:59f., Gómez-Baggethun et. al 2010). Asafu-Adjaye (2005:10) defines *Ecological Economics* as sub-discipline of *Environmental Economics*. As *Ecological Economics* uses some neoliberal methods, one might think that it is a sub-discipline. I would, however, say that for being a sub-discipline the two approaches diverge fundamentally in underlying assumptions (see, e.g., preanalytic vision) (Gómez-Baggethun et al. 2010). This work will hopefully reveal these differences.

2.2. Intellectual genealogy of Ecological Economics

Ecological Economics as a discrete school of thought dates back to the 1980s (Bergh 2001:13, Venkatachalam 2007:550), however its roots are much older. Martinez-Alier (1987) wrote a comprehensive book about *Ecological Economics* tracing back its roots to the second half of the 19th century. The intellectual fathers of *Ecological Economics* were mostly natural scientists, who tried to capture economic activity with biophysical indicators. The basis for these input-output considerations and calculations was human appropriation of low entropy energy and its inevitable transformation into high entropy energy (see also Barnett 1960:440ff.).

According to Martinez-Alier (1987:47) one of the first scientists who dealt with input-output considerations was the Ukrainian physician Serhij Podolynskyj, who lived in the second half of the 19th century. The first input-output calculations were conducted in the field of agriculture, hunting and fishing, since other human activities would have been too complex to calculate at that time. The first analyses were already based on the notion of entropy, and even if it was not made explicit, Podolynskyj already assumed that the only source of energy was the sun, thus he perceived the earth as a closed system (Martinez-Alier 1987:47). The insights from the studies of

energy flow, from input-output considerations and from thermodynamics, are the basis for human ecology "[...] and economy could be analyzed in terms of concept of energy return to human energy input, in a framework of reproduction of social systems […]" (Martinez-Alier 1987:52). Eduard Sacher is, together with Podolynskyj, one of the first authors who wrote about energy and human society. Sacher assumed that natural science could provide the basis for economics (Martinez-Alier 1987:64f.). According to Martinez-Alier's research, Sacher came to similar conclusions as Podolynskyj. Martinez-Alier (1987:71) points out that Podolynskyj's and Sacher's findings reappear again and again in the discourse.

One famous name not mentioned so far, who often is said to be an intellectual father of *Ecological Economics,* is Malthus. Martinez-Alier (1987:99ff.) did not support the opinion that Malthus is one of the intellectual fathers of *Ecological Economics*. He rather points to his contribution to *Social Darwinism*, entailing the "the fittest survive" concept and to the nationalist or fascist notions such ideas can have (Martinez-Alier 1987:100f., Seidl / Tisdell 1999:396ff.). Other authors do relate Malthus to *Ecological Economics* through the concept of absolute scarcity that limits population growth and economic prosperity (Venkatachalam 2007:553, Pearce 2002:60, Barnett 1960:427ff.).

Other scientists that Martinez-Alier refers to are Rudolf Clausius (pointing out the importance to shift energy consumption from non-renewable to renewable resources) (1987:73ff.), Patrick Geddes (emphasizing the necessity to include physical indicators in economics and criticizing the concept of utility) (Martinez-Alier 1987:89ff.), Leopold Pfaundler (writing about carrying capacity) (Martinez-Alier 1987:103ff.), and Frederick Soddy (second law of thermodynamics and accumulation of financial capital) (Martinez-Alier 1987:127ff.). Another author that is referred to as being one of the intellectual fathers of *Ecological Economics* is Kenneth E. Boulding, with his 1966 essay *Economics of the Coming Spaceship Earth*. In this essay he makes the metaphor of Planet Earth being a space ship. In doing this he illustrated the limits of resource supply and connected thermodynamics with economy (Daly 1996, Pearce 1002:60, Bergh 2001:14, Asafu-Adjaye 2005:11). Pearce (2002:60) assigns Boulding the role of founding *Ecological Economics*: "Boulding's essay remains to this day the basis of ecological economics, where the focus is still on physical limits and where technological change through human capital formation is not regarded as an obvious and viable means of escape from those limits."

More recent contributions to *Ecological Economics* are Gerogescu-Roegen[2] (thermodynamics), Herman E. Daly (steady state economy), Robert Costanza and, of course, Martinez-Alier himself (Bergh 2001:14).

2 See special issue in *Ecological Economics* (Volume 22, Issue 3, September 1997)

Demonstrating the long history of *Ecological Economics,* Martinez-Alier (1987:143f.) wondered why *Ecological Economics* could not evolve as a discrete school of thought much earlier. With his book (*Ecological Economics: Energy, Environment and Society,* 1987) and as a founding member the *International Society for Ecological Economics* (ISEE) (see ISEE) in 1989, Martinez-Alier contributed to the formation of *Ecological Economics* as an independent school of thought. The ISEE's journal *Ecological Economics* communicates the Society's issues. Through the Society, its journal and several books on *Ecological Economics*, the school of thought finally became institutionalized (Bergh 2001:14).

The roots of *Ecological Economics* thus lie in the analysis of nature-human interactions and how this can be expressed in biophysical terms. Venkatachalam (2007:550) states that *Environmental Economics* as a neoclassical sub-branch provides rigorous analytic tools. However, it does not consider the larger context, therefore *Ecological Economics* evolved in the 1980s to meet this shortcoming.

3. Preanalytic vision of Environmental and Ecological Economics

3.1. Preanalytic vision of Environmental Economics

Daly (1996:6) introduces, referring to Joseph Schumpeter, the concept of preanalytic vision.[3] This vision is the lens through which people see, analyze and understand reality. The vision shapes our understanding; issues that are not included in the vision are not reflected. The influence of the preanalytic vision is, is for example, also pointed out by Rees (2001:1):

> Virtually all 'official' international agencies and national governments share a comprehensive vision of global 'sustainable development' centered on unlimited economic expansion and fuelled by more liberalized trade. At the heart of this expansionist vision (also called the 'dominant economic paradigm') is the belief that human welfare can be all but equated with ever-increasing material well-being (income growth). This contemporary myth has been the principal force giving shape and direction to political and civil life in both industrialized and so-called developing countries on every continent at least since the 1960s.

People having different visions have different understandings about certain issues in question, because of the different lenses though which they see the world (Munda 1997:221). Daly discusses this issue and presents a graph of how the economic system is perceived by environmental economists and neoliberal economists, respectively.

3 Rees (2001) calls this preanalytic vision myth.

As can be seen in Figure 1, environmental economists perceive the economy as an isolated[4] system, nothing entering and nothing leaving the economic system. It is a circular, mechanistic system that runs like a perpetual motion machine, rendering infinite transformation of production factors into goods and services, and back again into production factors.

Environmental Economics does not neglect the role of natural resources for the economic system, but like neoliberal economics, the resource is not determining or limiting the functioning of the economy. This perception seems to be the reason nature is simply not displayed in such models. The prevalent preanalytic vision does not tolerate serious concerns about biophysical limits or distribution. “The neoclassical view does recognize externalities, but these are considered to be correctable by substitution or technology, and do not constitute a limit to the growth of the economic subsystem.” (Daly 1996:159)

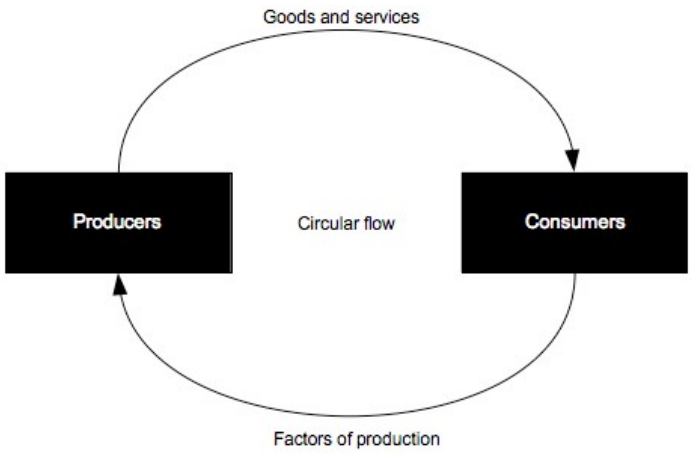


Figure 1: Isolated economic system (adapted figure after Daly 1996:47, similar figure in Hoag and Hoag 2006:252, Costanza et al. 2009:3)

Neoliberal economists see the economy as an isolated system[5] since there is no reference to interactions between the environment and the economy (Munda 1997:213, Daly 2006:47). “Neoclassical economic theory […] is at bottom a static model of pure exchange. The assumptions of the neoclassical model lead to the optimal […] allocation of a given stock of resources with a

4 Usually it is described as a closed system. However, I use isolated system as I want to reflect the categorization of systems which can be found in thermodynamics. This will be explained later.

5 Rees (2001:2) describes the economic system as an open infinite, ever-expanding system. I *think that they more or less express the same, while the figure of Rees shows the more recent perception within neoliberal economics, acknowledging environment as an influential factor to the economy. However, it remains somehow influential, rather than limiting.* Rees (2001:4) also sees the system as mechanistic and circular, referring to Daly.

given initial distribution" (Gowdy / Olsen 1994:165).

The concept of externalities, which will be introduced below, can easily be connected to the isolated economic system. Environmental resources are not included; they are external to the model. Only man-made goods and services are depicted. The natural resources are, following the belief of *Environmental Economics*, resources that can be exchanged with other natural resources as well as with man-made goods and services. Moreover, it is assumed that other production factors can substitute natural resources in the production process. Hence natural resources are a negligible resource (see Cobb-Douglas Production function).

Environmental economists do not understand the integration of environmental issues into the neoliberal economic model as a subordination; rather, it is the way they see and analyze environmental problems (Wiesmeth 2012:45). Understanding the differences between the two compared economic schools of thought, it will be of major importance to keep this preanalytic vision in mind.

3.2. Preanalytic vision of Ecological Economics

Environmental Economics has a different preanalytic vision than *Ecological Economics*. Comparing the two different preanalytic visions immediately illustrates the conceptual, analytical and intellectual differences between the two economic schools of thought. Daly (1996:11) states that one can see the world through three different lenses:

- economic imperialism: everything is seen as part of the economy
- ecological reductionism: everything is seen as part of environment and natural laws[6] apply.
- Middle way: economy is seen as a subsystem of the environment (Daly 1996:11)

Ecological Economics takes the "middle way", while *Environmental Economics*, as already shown above, takes the "economic imperialism" strategy (Daly 1996:75, Rees 2001:8). Hence *Ecological Economics* links the economic and human system with the environmental system (Munda 1997:220). Moreover, *Ecological Economics* acknowledges the economic system's dependence on the biophysical world and thus perceives the economic system as a subsystem of the ecosystem. These systems are open and depend on the low entropy energy inflow and produce high entropy energy (Rees 2001:8f.). Instead of adapting the old system again and again, Daly argues, "What is needed is not ever more refined analysis of a faulty vision, but a new vision" (Daly 1996:48).

From Figure 2 above one can now see that the *Ecological Economics'* preanalytic vision is much bigger. It includes the environment within which the socioeconomic system is embedded. From the

6 "The fittest survive", social Darwinism (see Martinez-Alier 1987).

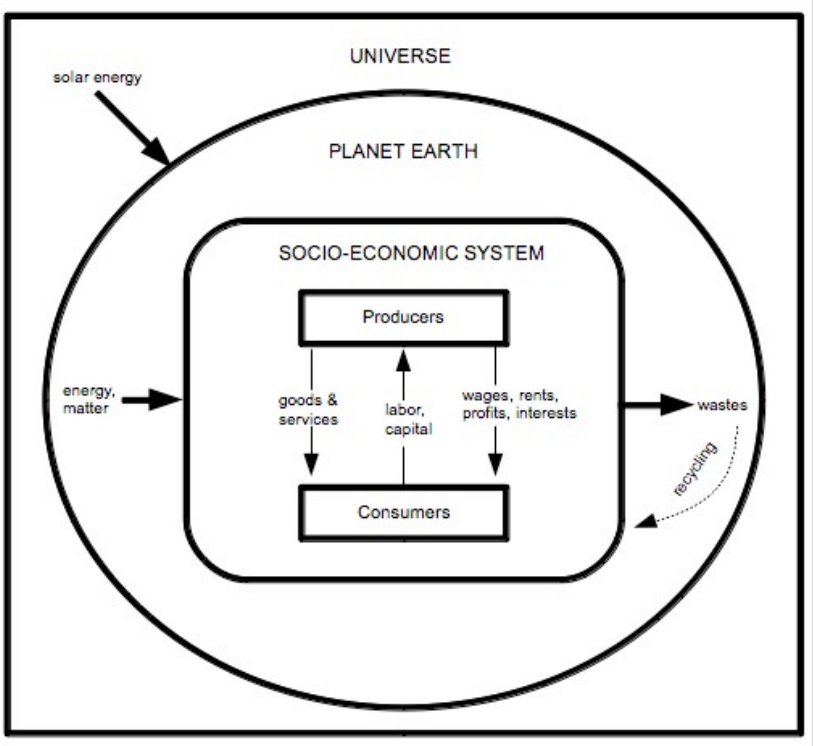


Figure 2: Ecological Economics' preanalytic vision (adapted figure after Asafu-Adjaye 2005:17)

figure one can also see that the environment offers certain functions and / or services to humans, like provisioning services (source) or an absorptive function (sink). Apart from this, humans also profit from other life support functions and amenity services (Asafu-Adjaye 2005:18, compare MEA 2005). It needs to be pointed out that the preanalytic vision that *Ecological Economics* uses acknowledges the systemic interrelation but still depicts the system from an anthropocentric point of view. The economy, hence humankind, is in the center and thus the ecosystem functions or services are only analyzed in relation to human needs. It does not show functions that are used by other entities that are part of the ecosystem. However, *Ecological Economics* is aware of the ethical implications and emphasizes the intrinsic value of the ecosystem and its constituent parts, apart from human appreciation (Costanza et al. 1997). Additionally, even if not represented in the figure, *Ecological Economics* also deals with the limits of the ecosystem to provide the ecosystem services. The system thinking that is usually applied acknowledges feedback loops, non-linearity and uncertainty concerning the interrelations between the constituent parts of the system and the sub-system, as well as the interrelations between the two systems as a whole. Acknowledging nature as the basis for human survival, *Ecological Economics* deals with questions like: How does economic activity negatively affect the ecosystem? How can the provision of services be improved without degrading it at the same time?

Ecological Economics deals with the stocks of natural capital and the flows that derive from (often

called ecosystem services) and return back to them (waste). From sources to sinks, matter and energy is flowing through the economic sub-system, a flow that Daly (1996) calls throughput. “The physical exchanges crossing the boundary between the total ecological system and the economic subsystem constitute the subject matter of environmental macroeconomic” (Daly 1996:48). The flows of matter and energy are compared to the relative magnitude of the ecosystem, which made Daly (1996) focus on the scale question. The biophysical flows supporting humans are the reason ecological economists refuse to measure economic activity merely through the monetary indicator.

Comparing the preanalytic vision of neoliberal economics with that of *Ecological Economics,* one can interpret the latter as an amendment of the former. This is very nicely illustrated in the paper of Costanza et al. (2009) about amendments to Gross Domestic Product (GDP). Explaining how GDP is measured, they present the preanalytic vision illustrating the isolated flow presented above. Explaining that amending GDP, thus including social and environmental factors, the picture illustrating this idea changes.

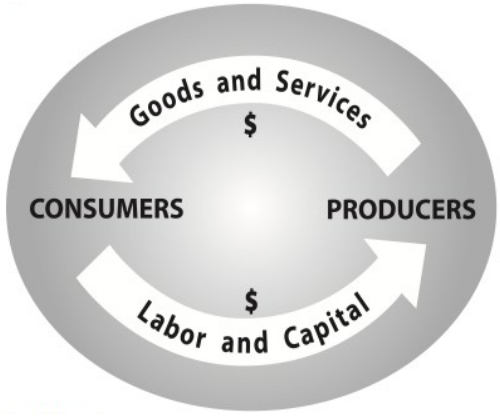


Figure 4: Market system. Isolated circular system with no relation to the social or natural sphere (Costanza et. al 2009:3).

Figure 3: Ecological Economics' understanding of human-nature relation (Costanza et. al 2009:8)

As already pointed out, including the environment and the biophysical laws (like thermodynamics) into the model results in acknowledging that the economic activity is limited by resource availability and the environment’s absorptive and reproductive capacity. Haberl et al. (2004:13) moreover indicate that this view can even be further developed, since maximizing production within the reproductive capacity can still lead to degradation. Therefore economic activity should allow enhancing ecosystem resilience. These two figures can be compared with the one presented in the

United Nations Environmental Program Green Economy Report (UNEP GER) (2011:507, see also Figure 22 in this thesis). In this figure the environment is already included, though the biophysical laws it is bound to are not. Thus the story was thought out a bit further but not to the end.

From *Ecological Economics'* preanalytic vision one can also understand why it is rather interdisciplinary (even transdisciplinary). As one can see, the figure of the *Ecological Economics'* preanalytic vision entails much more than just the financial and economic world. The socio-economic system depicted focuses on human-nature interactions. Analyzing more than just the monetary flows requires the integration and cooperation of several disciplines. Thus *Ecological Economics* is not only more open and holistic concerning the preanalytic vision but also concerning the scientific knowledge base (Haberl et al. 2004:199).

4. Core Concepts of Environmental and Ecological Economics

4.1. Core Concept Environmental Economics

Environmental Economics is the environmental responsive branch of neoliberal economics. Hence the neoliberal economic theory and logic is extended to the environment, due to increasing environmental problems (resource scarcity and pollution) and the necessity to solve them. It is believed that the neoliberal economic concept can be expanded and through some minor adaptations; environmental problems will be included in the economic system and through its mechanisms, they will be solved. Environmental problems are perceived as externalities that are unintended byproducts of economic activity and happen due to missing markets. Thus the main aim of *Environmental Economics* is to internalize these externalities and to manage resources in the most efficient way (Wiesmeth 2012:3f., 45, Bergh 2001:15, Venkatachalam 2007:550f., Munda 1997:216, Asafu-Adjaye 2005:23, Müller 2001:423). The importance of internalizing externalities is best illustrated through the following quote: “It follows immediately from the concept of an *external effect* that many, if not most ‘man-made’ environmental problems are in one or the other way the consequences of an externality” (Wiesmeth 2012:61).

The inclusion of environmental commodities into the market system is bound to the conditionality of perceived relative scarcity. Only if a good or service is perceived as being relatively scarce, does it become relevant for economic analysis (Wiesmeth 2012:3, 44ff.).

> The concept of a *good*, or equivalently, a *commodity*, comprising both a *physical commodity* or a *service*, is basic for any economic system and can be extended to include *environmental goods* or *environmental commodities*. Like any other good, environmental commodities influence the well-being of mankind in general, or of *economic agents*, consumers and producers, in particular. However, as the case with regular commodities, only perceived *scarcity* renders environment commodities relevant for a rigorous economic analysis. (Wiesmeth 2012:45)

This inclusion of environmental commodities could be understood as subordinating the environment under the economic system. Wiesmeth (2012:45ff.), however, emphasizes that this is not intended by extending the economic system; rather, it should help analyze the environmental problems in an economic context.

Daly (1996:11) called this neoliberal strategy of internalization economic imperialism. He states that this leads to the situation where everything is internalized until the economic system equals the total system. “Internalization of externalities has been carried out to the limit and nothing remains external to the economy. This seems to be the implicit strategy of neoliberal economics” (Daly 1996:11).

Not every external good or service is internalized, since two factors need to be fulfilled. These two conditions are (a) contributing to human welfare, hence being useful to economic agents and (b) being perceived as relatively scarce (Wiesmeth 2012:45).

4.1.1. Utility

Humans are only willing to pay a certain amount for a commodity, if it is useful to them. As all commodities traded on the market need a price, usefulness of goods and services is one of the key conditions attaching value on them. Thus the utility that humans experience or expect from environmental commodities is, within *Environmental Economics*, the source for environmental valuation (Venkatachalam 2007:553, Van den Bergh et al. 2000:43, Primeaux / Stieber 1999:203, Borgström Hansson 2003:76). “Economic valuation assumes the existence of a common essence of all wants, a unique want into which all wants can be merged into a mono-dimensional definition of utility” (Gowdy / Mayumi 2001:229). This mono-dimensional definition of utility is a key concept within economy theory since it allows the commensurability of all consumer wants (Martinez-Alier et al. 1998:278). The least common denominator is money. Everything can be expressed in monetary terms. As noted, the price tells the utility of a commodity, thus the same price expresses the same utility gains (Gowdy / Mayumi 2001:229). From this follows the unlimited substitution possible under neoliberal theory's assumptions (Gowdy / Mayumi 2001:230, Van den Bergh 2000:52).

Borgström-Hansson (2003:77) points out that it is

> [t]he role of environmental economics to assists in the development of methods and theories that can facilitate a balancing of environmental goods and other things that people may have preference for. To protect [it] the environment has a price in terms of foregone producer and consumer surpluses and whether that price is worth paying or not depends on how much value people put on environmental

quality.

In neoclassical theory utility is defined through the pleasure a commodity provides or the pain it eases.[7] From this the ethical correctness of an action derives. An action is ethically good as long as it increases the (individual) pleasure and decreases the (individual) pain. Welfare describes the overall utility of a society. Pareto efficiency will be introduced later; however, considering overall welfare, for *Environmental Economics* the efficiency of the allocation function is more important than equity concerns. (Daly 1996) Hence what matters most is that overall welfare increases; whether this implies that the ones with already high utility gain more than those with lower initial utility is not of top priority. Generally one could include the effects of an action on the utility of all creatures that are able to feel pleasure or pain. However neoclassical theory only takes into account humans and is thus anthropocentric. Utility is measured according to an individual's preferences, which are not evaluated by any other ethical framework than Utilitarianism (Common / Stagl 2005:7ff., Müller 2001:418).

4.1.2. Scarcity

Common and Stagl (2005:190) state that one characteristic of economics as science is that it deals with the management of scarce resources. Thus scarcity lies at the heart of economic theory. Wiesmeth (2012:45f.) explains that perceived relative scarcity depends on two factors. The first one is the factual relative scarcity recognized (usually through scientific *evidence*) by humans. Hence a good only gets scarce through human recognition. He admits that therefore scarcity is dependent on human knowledge from scientific research (Wiesmeth 2012:45f., Common / Stagl 2005:474, Barnett 1960:433). He uses the example of the ozone layer depletion that became only acknowledged through scientific research (Wiesmeth 2012:46).

Defining scarcity in this way, he puts the cognitive abilities of the economic agents, the *homo oeconomicus*, in the center of regulating the allocation of the good. It is not the market *per se* that reacts through an inbuilt mechanism when a resource gets scarce. The market system needs the economic agent to react.

However the knowledge concerning scarcity is, as already stated, dependent on state-of-the-art research. But this alone is not enough to direct human actions. It is not only the knowledge of scarcity; it is also how scarcity is perceived by humans. Therefore the attitude of the economic

7 Martinez-Alier (1987:87) explains the origin of the theory of value, which can be dated back to Jevons (*Theory of Political Economy,* 1871). Jevons referred neither to intergenerational distribution of resources nor to the finiteness of natural non-renewable resources. He rather studied the rules of general economic equilibrium using a mechanistic approach. This was the basis for economic value theory that evolved afterwards.

agent matters. Following Maslow's pyramid of needs, Wiesmeth (2012:46) states that usually the perception or the awareness of scarcity is positively correlated with GDP, thus with the level of economic performance of a nation. Hence this second notion of scarcity is related to a changed utility of economic agents. Pearce (2002:58) points out that the evolution of the school of thought of *Environmental Economics* was possible through greater valuation of external costs caused by intensive agriculture.

> The costs take the form of "external effects," in this case the alleged loss of biological diversity about which people had begun to care far more than previously. It is no surprise, then, that economists began to link the theory of external effects with an economic interpretation of the rising tide of environmentalism. (Pearce 2002:58)

All this refers to the relevance of the so-called *Environmental Kuznets Curve* (EKC), which will be discussed later.

Borgström-Hansson (2003:75) states that the major difference between orthodox economics and *Environmental Economics* is the extension of the scarcity idea to the environment. Boulding (1966) illustrates this shift with his essay *The Economics of the Coming Spaceship Earth*. With increasing population density and increasing impact of human actions on the environment, the resources provided by the environment became scarce.

Wiesmeth (2012:51) states that there is only the problem of how to motivate producers and consumers to act in an environmentally friendly or friendlier way, hence how to alter the market system to an ecological market system. Ibrahim et al. (2012:39) also point to the importance of environmental awareness as key to adapt behavior. However, they indicate that translating environmental commodities in monetary value is pivotal.

> A first step towards raising public support is describing and explaining the causal links between land degradation and other economic activities, in physical terms. When these impacts are measured in monetary terms, they are more likely to capture the attention of policy-makers, business leaders and those in charge of public finances (all of whom are potential "buyers"). (Ibrahim et al. 2012:39)

After introducing the core concepts of *Ecological Economics*, the basic assumptions and the functioning of the market system will be explained.

4.2. Core Concept of Ecological Economics

Ecological Economics is an alternative to the neoclassical approach, tackling the problems that the neoliberal system leaves blind. It deals with ethics, incommensurability, irreversibility, marginal utility (allocation), uncertainty, the biophysical world as basis for economic activity and environmental sustainability as a precondition for economic activity (Gowdy / Olsen 1994:170, Martinez-Alier 1987, Daly 1996). *Ecological Economics* combines "[...] elements from economics,

ecology, thermodynamics, ethics, and a range of other natural and social sciences to provide an integrated and biophysical perspective on environment-economy interactions [...]" (Bergh 2001:13, Asafu-Adjaye 2005:12f., Martinez-Alier 1987, Daly 1996). The aim of *Ecological Economics* is to reach sustainable[8] development (inter- and intra-generational). It acknowledges the limits to growth determined by the biophysical world and thus wants to employ biophysical units and indicators to accomplish economic analysis (Bergh 2001:13). Generally *Ecological Economics* can be defined as a school of thought that examines the relation between economy and nature, in which humans are seen as part of a larger whole (Asafu-Adjaye 2005:10). The comprehensive analysis of the roots of *Ecological Economics* illustrates that the biophysical world is perceived as one major determining factor (together with socio-cultural ones) of economic activity (Martinez-Alier 1987).

Bergh (2001:17) points out that *Ecological Economics* suggests a combination of traditional neoliberal methods with insights from natural science. Expanding the model and thus including nature, the general equilibrium model gains new significance (Müller 2001:224). Generally *Ecological Economics* promotes balancing knowledge and findings from economy and natural sciences. One of the intellectual fathers that criticized economics not taking into account natural science was Geddes. He was in correspondence with Walras, criticizing his work. Walras, together with Jevons and Carl Menger, are supposed to be the founders of neoclassical economy, who contributed the marginal theory of utility. According to Geddes there are different fields within economics that should be taken into account separately concerning their relevance to natural science. These fields are statistics, theory of exchange and the use of natural resources. The last one requires taking into account natural science and does not allow being merely based on mathematics (Martinez-Alier 1987:89f.). Martinez-Alier (1987:90) notes that "[t]he distinction between theory of exchange and studies of the utilization of resources is exactly the distinction between orthodox economics […] and ecological-institutionalist economics."

As was pointed out in the history of *Ecological Economics*, its roots are to be found in natural science. This, however, does not imply that ecological economists want to substitute one unidimensional indicator with another one (Martinez-Alier 1987). "Human energetics is in *no way* a theory of value, but a contribution to the critique of theories of value proposed by economists" (Martinez-Alier 1987:92). As already illustrated, the roots of *Ecological Economics* stem from energy flow considerations. Not only economic activity but also the human body itself can be analyzed by its energy needs. The question for *Ecological Economics* is how much energy is needed for a certain process, how much energy is getting lost while processing and how much

8 For *Ecological Economics* sustainability always means strong sustainability. Of course *Environmental Economics* also wants to achieve sustainability. This, however, usually means the weak notion of sustainability.

energy is available. Such considerations unravel the efficiency of processes and allow a comparison between different processing methods in their energy needs. Moreover, one can calculate whether energy supply and the demand for processes is sustainable in terms of long term availability. Hence not only *Environmental Economics* cares about efficiency; *Ecological Economics* does, as well. But efficiency is measured through different means and units. For *Environmental Economics* efficiency is determined through the monetary input-output relation. In contrast *Ecological Economics* measures the input-output relation of energy and matter. So the latter measures efficiency directly, and the latter needs an intermediary: monetary units expressing the market value of inputs and outputs.

Martinez-Alier (1987) emphasized that *Ecological Economics* does not strive to a new reductionism on energy accounts. First not only energy consumption matters for sustainability; matter does also. Water, air, ores, nutrients, and resources such as soil must be taken into account for sustainability considerations. A simplistic input-output calculation of energy consumption does not reflect these sensitive resources. The availability of resources in the long run shows how sustainable their usage is. Since the environment is not only the source but also the sink, resource disposal and the absorptive capacity of the sinks is vital. Moreover, the actual consumption of energy and matter cannot merely be explained through biophysical analysis. Humans have a certain minimum need for energy to sustain their body functions, while humans use even more than this minimum. Not only the amount of energy consumed, but also the source of energy differs. These factors can only be explained through cultural and social differences. Martinez-Alier (1987:48) refers, for example, to Podolynskyj, who already noted that poverty cannot merely be explained through the availability of energy, but rather through the circumstances created through social classes. This indicates that the distribution of energy and matter is separate from the allocation or the general availability. As will be shown in a later section, this is why Daly insisted that scale, distribution and allocation are separate things that need to be tackled separately. One cannot expect one function (e.g., allocation) to automatically balance the others.

From this it follows that *Ecological Economics* is not just economics from the perspective of natural scientists; rather, it is a school of thought that dissociates from specialization. The aim is to get a holistic picture, which is not possible employing only a single discipline, therefore *Ecological Economics* is multi-, inter- and transdisciplinary (Bergh 2001:13). From the plurality of publications in the field of *Ecological Economics* Bergh (2001) concludes that *Ecological Economics* does not strive to develop one uniform theory; rather, they want to keep it pluralistic. This is in harsh contrast to neoliberal economics, where a clear uniform standard approach exists. “The emerging ‘transdiscipline’ of ‘ecological economics,’ with its society and journal of that title, are providing a

bridge to unite economics and ecology in the furtherance of sustainable development" (Daly 1996:73).

5. At the heart of Environmental Economics: The market system, its shortcomings and adaptations to environmental externalities

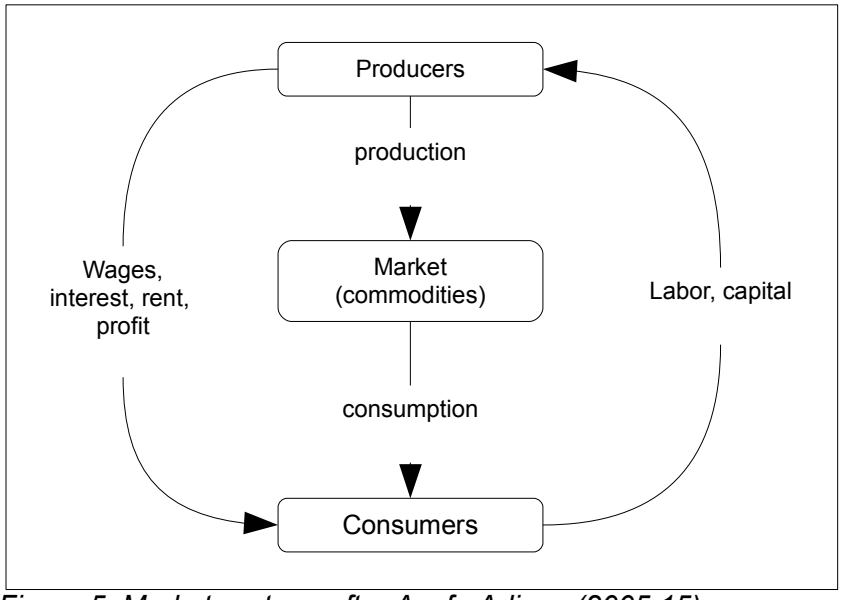


Figure 5: Market system, after Asafu Adjaye (2005:15)

The market system is comprised of economic agents – producers and consumers – who communicate and interact through the market mechanism to exchange goods and services. As will be discussed later (see production function), to produce commodities one needs labor, (financial) capital and resources, that are also exchanged on the market (Asafu-Adjaye 2005:14,40). The model of the market system is usually represented as an isolated one (see preanalytic vision) that only depicts the exchange of the economic agents through the marketplace. As Daly (1996:47f.) points out, the model of the economic system is isolated from the biophysical world. Within the abstraction of the circular isolated economic system, it is no problem to omit the relation between nature and the economy. Daly (1996:47) argues that for certain purposes such an abstraction has its legitimacy, but that one needs to be careful for which purposes one uses this model, since it completely obscures the biophysical basis of the economic system (see also Asafu-Adjaye 2005:26f.).

The well functioning of the market system is built on some assumptions that should facilitate

perfect competition.[9] These assumptions comprise the composition of economic agents, their impetus for action and cognitive abilities, that the market prices capture the full value of traded commodities, and that commodities are homogenous, which means that for the economic agent it does not matter by whom the commodity is produced. Additionally, ownership and property rights need to be defined properly. Composition of economic agents means that for perfect market competition, there have to be enough buyers and sellers, which must not have the power to manipulate the market price or the supply. Their participation in the market system should not be restricted, hence they are free to enter and exit the market. Moreover, economic agents have perfect knowledge about market prices and market supply and their actions are led by the impetus to maximize their utility. In maximizing utility economic agents only think about their own satisfaction, thus they are led by pure self-interest.

It is further assumed that the economic agent is indifferent. This implies that for satisfying the demand of economic agents through a bundle of commodities, the exact composition of the bundle does not matter. Indifference is based on three more assumptions: a) non-satiation, which means that more is always better, b) strict convexity, which describes consumer choice as smooth and continuous, and c) transitivity, which relates to the preference ordering of commodities (Asafu-Adjaye 2005:40ff., Gowdy / Olsen 1994:162, Wiesmeth 2012:53ff., Van den Bergh et al. 2000:45, Müller 2001:418).

Box 1: Assumptions for the functioning of the market system

- composition of economic agents
  - enough buyers and sellers
  - no power to manipulate the market
  - free participation
- perfect knowledge of economic agents
- imperative of economic agents: maximize utility
- Indifference of economic agents
  - non-satiation
  - strict convexity
  - transitivity

9 Wiesmeth also bases his calculations on these assumptions in his work: *Environmental Economics: Theory and Policy in Equilibrium.*

It is assumed that the consumers have perfect knowledge about and the cognitive ability to compare bundles of commodities. Thus they can rank their preferred bundles in order to satisfy their needs and wants (transitivity). The preference is believed to reflect economic agents'[10] utility gain (Asafu-Adjaye 2005:42, Wiesmeth 2012:53ff., O'Neil / Spash 2000:4). From these preferences and the following choice of commodity bundles a demand curve can be created. The demand curve illustrates the relation between the prices that the economic agent is willing to pay for a certain commodity. Thus it illustrates the economic agent's willingness to pay (WTP) (Asafu-Adjaye 2005:43f.).

The other side of the market system is the supply side, which is reflected through the supply curve. The suppliers' (producers, retailers, etc.) imperative is also to increase their utility. However, they derive increased utility through profit maximization, therefore they try to increase the ratio between inputs needed for production and the output that is sold on the market (Asafu-Adjaye 2005:49).

Both curves can be combined; where they intersect, the so-called equilibrium price is located. This is the market clearing price, which means that the supply exactly satisfies the demand (Asafu-Adjaye 2005:50, Müller 2001:424). If all conditions listed above are fulfilled, in a perfect competitive market efficient allocation is achieved (Asafu-Adjaye 2005: 64).

5.1. Allocation

The main focus of concern of neoliberal economy is allocation. Allocation is about efficient provision of basic materials for the production of goods and services. Thus allocation deals with providing certain amounts (scale in microeconomics, see Daly 1996:50) of resources to different competing production sectors, with different competing methods of production, within a production sector. Moreover, allocation is about the access and conditions for the access to the products (Wiesmeth 2012:47, Bergh 2001:15).

The allocation mechanism needs a platform and a value unit to organize the most efficient provision of resources. This platform is the marketplace, where money is the unit. Optimal allocation can only be achieved if a market for the respective commodity exists (Wiesmeth 2012:47).

The allocation mechanism of the market system is deemed leading to optimal efficiency[11] or Pareto

10 Gowdy and Mayumi (2001:225) present seven axioms the economic agent alias *homo oeconomicus* follows according to neoliberal economic theory.

11 Primeaux and Stieber (1999) write about the ethical implications of efficiency. According to their explanations operating efficiently is ethically correct. Efficiency "[...] guarantees the community the

efficiency (Hicks 1936). Efficiency is a core topic for *Environmental Economics*, since the inefficient use of (natural) resources leads to its unnecessary depletion, over-exploitation, pollution and environmental destruction (Primeaux / Stieber 1999:201f.). That resources are used in an inefficient way is due to the lack of a market where the respective resource is traded and thus the allocation mechanism does not work (Wiesmeth 2012:50). Efficiency is the ratio between the output of manmade capital and the input of manmade and natural capital. The more we get out of the least input, the more efficient we are (Daly 1996:84). Increasing efficiency is desired by the economic agent, since it allows profit maximization. Moreover, it is believed to have positive effects on wellbeing (Wiesmeth 2012:49). Apart from this, increasing the efficiency of resource use for the production of manmade capital is a legitimate goal that can indeed facilitate environmental preservation (Daly 1996).

Extending the market mechanism – internalizing – to environmental commodities, the allocation mechanism is also applied to these resources. The goal is to reach an optimal level of externalities, which is facilitated through trading off social costs and benefits resulting from a certain level of externalities. Ideally this should lead to the so-called Pareto efficiency or at least to potential Pareto efficiency (Bergh 2001:15).

Applying the allocation mechanism to environmental commodities is within *Environmental Economics* a rather pragmatic concern. It is argued that one can weigh the trade-offs between manmade commodities and environmental commodities. According to Wiesmeth (2010:50) this is the same trade-off as between having more cars or more houses. “Thus there is no intrinsic, no natural controversy between the economy and the environment, given the *Pareto Criterion*, and environmental issues should be integrated into the economic system [...]” (Wiesmeth 2012:50).

Pareto efficiency is a normative concept[12] that describes optimal allocation, and is given if no one can be better off without making someone else worse off (Wiesmeth 2012:49, Asafu-Adjaye 2005: 63, Pearce et al. 2006:32). Stavins (2007:1) states that Pareto efficiency is hardly achieved in reality. However, a potential Pareto efficiency could be gained if the profiteer compensates the loser. This is called the *Kaldor-Hicks Criterion*, which is the basis for CBA (Stavins 2007:1). Kaldor and Hicks are the intellectual fathers of welfare economics, combining CBA with the idea of

maximum amount of goods and services produced from a given set of scarce resources” (1999:201).

12 Common and Stagl (2005:6f.) discuss the difference between normative and positive concepts in relation to economic theory. Normative expresses how it ought to be in order to fulfill certain assumptions about an optimal state. If a normative concept is good or bad cannot be proven in reality, since it is born out of certain hypothetical, probably ethical, assumptions. Pareto efficiency, for example, does not regard equality. So it does not strive for minimizing and eventually eliminating the gap between poor and rich. (Common / Stagl 2005:11)

compensation. CBA is a tool illustrating costs and benefits of investment options. The implementation of an option is generally justified given the benefits being greater than costs. The innovation of the *Kaldor-Hicks Criterion* is that losers could get compensated for bearing the costs, without canceling out net benefit of the gainers. For potential Pareto efficiency this compensation does not have to take place (Pearce 2002:58f., Pearce et al. 2006:32).

5.2. Open access goods or common goods

As already mentioned, externalities are the effect of non-existing markets. However, there is a second problem, apart from non-existing markets, and this relates to the characteristic of most environmental goods and services. Most environmental commodities are open access or common goods that are featured through *non*-excludability, non-rivalry and zero marginal cost (Wiesmeth 2012:47, Asafu-Adjaye 2005:66f., Common / Stagl 2005:325). Non-rivalry describes the instance where the consumption of the commodity does not minimize its availability for others and that the supply of this good is not affected by the consumption of others. This is the case for air that humans breathe or the protective service of the ozone layer. Non-excludability describes the circumstance that one consumer cannot and should not exclude another one from consuming the commodity. This is the reason such commodities cannot be traded on a market (Wiesmeth 2012:48, Asafu-Adjaye 2005:41, Common / Stagl 2005:325f.). The difference between open access goods and common goods[13] is that the latter entail some kind of rules for the use of the good, while for the former no such rules exist (Pearce 2002:59).

The differentiation between public and private commodities is not clear-cut and some subcategories exist that exhibit different characteristics. For example, “open access and common property goods” fulfill all criteria of public goods, except for non-rivalry. This applies for fisheries, where fished resources are no longer available for others (Asafu-Adjaye 2005:67).

Several problems arise from the characteristics of open access goods, leading to market failure. One is the tragedy of the commons,[14] implying that the characteristics of open access goods lead to over-exploitation (Asafu-Adjaye 2005:68, Hardin 1968). The first author indicating the tragedy of

13 Open access goods and common goods are often confused. Pearce (2002:59), e.g., points out that Hardin in his famous paper *The tragedy of the commons* confuses the two (see Hardin 1968). Asafu-Adjaye (2005) also confused the two, referring only to common goods. He (2005:68) points out that for common goods it depends on the management practices whether overexploitation occurs or not. This is the difference between open access and common goods. For the former there is no chance to mitigate overexploitation threats through arranged rules for usage. The problem for common goods is rather made up through rules that promote unsustainable management practices. In contrast, for open access goods rules have to be set up in the first place, which may infringe personal freedom.
See also Common / Stagl 2005:338f.

14 See also the prisoner's dilemma (Wiesmeth 2012:67ff.).

the commons was Gordon in the middle of the 20th century, illustrating it in the field of fisheries (Pearce 2002:59). The tragedy of the commons is a result of the neoliberal economic system and its underlying assumptions. According to Adam Smith everyone should act following his or her self-interest. Through the “invisible hand”, egoistic actions lead to an increase in overall welfare (Müller 2001:418). Now considering an open access good, which everyone can use, individualistic actions regarding the limits of the particular good result in two deliberations. First, taking one more unit from the commodity leads to an increase in personal profit. Second, taking this additional unit probably leads to overexploitation, pollution, etc., which has negative effects on personal welfare gains. These negative effects, however, are shared by all participants. So one weighs off complete gain versus shared loss, where loss is smaller than gain; overexploitation is the result. This is what Müller calls the “back of the invisible hand” (Müller 2001: 419, Hardin 1968:1244, Wiesmeth 2012:74f., Common / Stagl 2005:339, 346ff.).

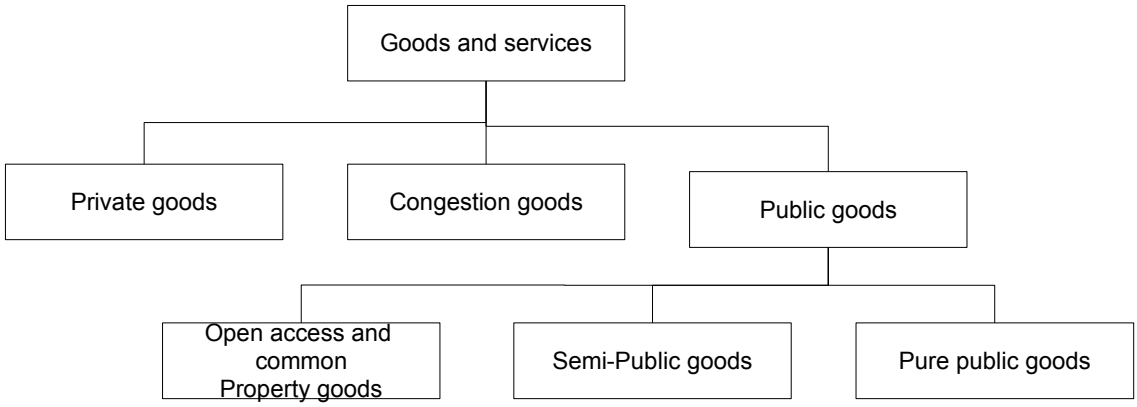


Figure 6: Categorization of environmental commodities (after Asafu-Adjaye 2005:66).

As already stated open access goods do not have rules for usage and they have the characteristic of non-excludability, which means that no one can exert property rights over the commodity. Hence even if one buys, for example, a part of the ozone layer, you cannot exclude someone else from using it or avoid its destruction through someone else (Wiesmeth 2012:47, Asafu-Adjaye 2005:66, Pearce 2002:59).

Concerning the consumption of open access goods, in contrast to private goods where everyone consumes different amounts, everyone consumes the same amount (Asafu-Adjaye 2005:69). If we want to include open access goods in the market we have to attach a monetary value to them. One commonly used method is to investigate people’s WTP. However, people may have a different WTP due to differing awareness, income, etc.; hence, different demand curves result, which are

then aggregated. Anyway, let's talk for example about air quality: I cannot exclude someone from breathing clean air. Hence if it is improved and to what price does not have an effect on consumption, since I cannot exclude someone else from breathing air. If we all gain the same profit form a higher air quality, but some have to bear the costs, why should they then pay for better air quality (Asafu-Adjaye 2005:69f.)?

Additionally, a WTP study might not deliver "correct" results, due to the free rider problem. Since economic agents cannot be prevented from consuming the commodity, people are not willing to reveal their true WTP (Common / Stagl 2005:326).

The characteristic of being an open access good is the very reason the economic system needs to be adapted in order to facilitate the proper allocative function of the market system. "However, characteristics of environmental commodities affect the allocative functions of the market mechanism, usually adversely. For this reason the framework conditions of a market economy have to be adjusted to allow a consideration of environmental issues" (Wiesmeth 2012:44). Open access goods mean that using them is not connected to any kind of regulation, thus one is free to use them. Adapting the market system in order to reduce the consumption of a specific open access good therefore also has the notion of limiting someone's personal freedom. Such a constriction is usually accepted by the population, since it is acknowledged that otherwise those who are unconscious about the negative effects of overconsumption are privileged. Regulating directly or indirectly the use of open access goods is thus a means to evade the tragedy of the commons (Hardin 1968).

5.3. Externalities

An externality is an effect that is external to the causing agent. If the causing agent experiences a negative effect he or she would have to internalize the effect in order to keep production at its optimum. Hence it is the fact that the effect of an action is not affecting the polluter that the effect is external to the market mechanism. A negative externality affects economic agents in reducing their utility (Asafu-Adjaye 2005:71, Wiesmeth 2012:59, Common / Stagl 2005:327). So an externality occurs if someone is unintentionally affected through someone else's actions. Another reason for externalities is the lack or weakness of property rights. If it is difficult to identify the polluter, it is hard to make him or her accountable for the pollution. A third cause for externalities is high transaction costs, which impede conflict settlement between polluter and affected party (Asafu-Adjaye 2005:72, Common / Stagl 2005:328). Wiesmeth (2012:60) argues that it is usually not the polluter's intention to affect others negatively. He refers to a car driver who causes noise and pollution, while the driver did not intend to do this. However, as it becomes clear from the last of the

three stated reasons for externalities, the polluter, even if he or she did not intend to pollute, often is not willing to internalize the externality, at least not when the costs for internalization (abatement costs, compensation, etc.) are higher than expected benefits. Moreover, Wiesmeth (2012:67ff.) refers to the prisoner's dilemma, which exactly exemplifies that economic considerations are often those of highest priority. So even if economic agents are aware of their negative externality producing actions, they will not give in.

> It is important to note that individual rationality, and not necessarily insufficient environmental awareness, prevents the economic agents from achieving a socially optimal result. In this sense, the outcome is more a consequence of the intrinsic nature of the environmental commodity, or the intrinsic nature of the external effect, and not so much a consequence of poor attitude towards the environment. (Wiesmeth 2012:70)

Asafu-Adjaye (2005:72f.) presents four categories of externalities:

- relevant externality: the externality must be relevant to someone. Remember what was mentioned here about the two preconditions for environmental goods to be considered economically. One of the conditions was utility, which generally strives to minimize one's pain and increase one's pleasure. Accordingly, if no one is affected in his utility the externality does not matter.
- Pareto relevant externality: internalization leads to a Pareto improvement, which means that the affected agent is made better off, without making someone else worse off. When the level of an externality is optimal it becomes Pareto irrelevant.
- Static and dynamic externalities: static is an externality that affects now; a dynamic one will affect only in the future.
- Pecuniary externality: externality that affects prices for other economic agents (e.g., increased rents), while Wiesmeth (2012:60) excludes pure pecuniary effects from being an externality.

Let us get back to the first reason for the occurrence of externalities: a polluter unintentionally affecting others. The problem derives from the difference between the individual and social costs. An individual or a company usually considers only the private costs and benefits, not those that occur for society (Asafu-Adjaye 2005:56, 74, Wiesmeth 2012:60, Pearce et al. 2006:31). The marginal social costs are usually higher than the marginal private costs. The real costs would be the marginal external costs plus the marginal private costs. Since society considers other costs than the private producer, the supply curve (reflecting unit costs and price of output) differs for the two stakeholders. The society wants a reduction in production while the private entrepreneur probably wants an increase. Since the environmental effects are not reflected in the price of the commodity, the private entrepreneur produces more than society desires. Internalizing the environmental effects (taxes, etc.) the product price would rise and thus production would

decrease and equilibrium is established (Asafu-Adjaye 2005:75). It has to be pointed out that the equilibrium does not mean a state of zero externalities, since society may accept a certain level of externalities (see *Coasian Solution*) (Asafu-Adjaye 2005:74).

5.4. Why markets fail

So there are two problems concerning the modification of the neoliberal market system in order to perform in the desired way. First there has to be a market for environmental commodities that would otherwise be excluded and second a solution to the open access good characteristics of natural commodities has to be found (Wiesmeth 2012:48).

Market failure happens when not all costs and benefits are reflected in the market price. The market failure results in an inefficient allocation (Asafu-Adjaye 2005:64, Hamilton / Lutz1996:1). Summarizing, there are four reasons for market failure:

- "lack of or weak property rights
- public goods and/or common property characteristics
- externalities, and
- type of market structure" (Asafu-Adjaye 2005:64, see also Common / Stagl 2005:325ff.)

Common and Stagl (2005:331f.) indicate that it is usually not only one problem that hinders efficient allocation. For example, already one or more of the conditions that allow the market to work properly (see BOX 1) are not fulfilled, together with the occurrence of externalities. If one cannot change one of the failures, then a second best solution has to be found (Pearce et al. 2006:32).

However, *Environmental Economics* is aware of these shortcomings and tries to overcome them. Several methods exist to internalize externalities, which will be introduced further below. Before turning to valuation methods, general and particularly critique from the *Ecological Economics* point of view concerning the market mechanism will be outlined. Thereafter I will expand on the *Cobb-Douglas* production function and the IPAT identity. Both equations are connected with each other, explaining how production factors and their influence in solving environmental problems can be interpreted. But before, the analysis of Herman Daly (1996) of the market's allocation function and its importance will be discussed.

6. Scale – Distribution – Allocation Herman Daly's hierarchy of economic priorities

The market, of course, functions only within the economic subsystem, where it does only one thing: it solves the allocation problem by providing the necessary information and incentive. It does that one thing

> very well. What it does not do is solve the problems of optimal scale and optimal distribution. The market's inability to solve the problem of just distribution is widely recognized, but its similar inability to solve the problem of optimal or even sustainable scale is not as widely appreciated (Daly 1996:50, see also 55f.).

Concluding from Figure 2 and the awareness that there is only a limited planet (material base), with only a limited inflow of low entropy energy, the growth paradigm of neoliberal economy becomes shaky. In neoliberal economy, hence *Environmental Economics*, it is believed that economic growth is the solution to everything and that growth is infinitely possible. Apart from the insight that one gets looking at the *Ecological Economics'* preanalytic vision, using one's human sense tells one that unlimited growth on a limited planet is a fantasy. Daly (1996) criticizes that scale is not considered by neoliberal theory on the macroeconomic level. For macroeconomy it is not assumed that the marginal costs of growth outweigh the marginal benefits of growth. In contrast to macroeconomics, in microeconomics optimal scale exists. It is assumed that the optimal scales within microeconomy also affect macroeconomy, leading to the optimal scale. “The macroeconomy is not seen as a part of anything lager […]” (Daly 1996:27, 60). The mismatch between macroeconomics and scale is due to the preanalytic vision, not taking the environmental limits into account (Daly 1996:60). However, if we add the subsystem idea, then we see that also the macroeconomy is part of a larger whole and thus has an optimal scale (Daly 1996:27).

For Daly (1996) one of the major concerns deduced from the preanalytic vision is related to the right scale of the whole economy related to the ecosystem. *Ecological Economics* perceives the economic system as a subsystem of the superior ecosystem. Therefore the question of optimal economic scale is important (Munda 1997:225). Daly (1996:50) defines scale as “[...] the physical scale or size of the human presence in the ecosystem, as measured by population times per capita resource use.”

As Daly (1996:53) pointed out, the scale component was completely neglected by neoliberal economics but needs to be taken into account. The question is what is the optimal size of the world economy? To what extent is it allowed to grow, to appropriate nature and still being economically sound and when does further expansion simply get uneconomic? This kind of scarcity does not refer to relative, but to absolute scarcity, which is related to the limited inflow of low entropy energy and the physical laws it obeys. Bergh (2001:15) states that since *Ecological Economics* is based on sustainability, scale is a major issue. Kubiszewski et al. (2013) illustrate that there is a maximum income level where life satisfaction is maximized but still remains within sustainable limits, assuming a certain level of population number and a certain rate of technological innovation. Indeed, such calculations cannot guarantee that at this particular economic scale sustainability is

really reached. However, it clearly shows that for ecological economists the question of what is the optimal scale matters.

For Daly (1996) the distinction between allocation as a problem of microeconomics and scale as a problem of macroeconomics is fundamental. Apart from the fact that within microeconomics scale is somehow considered, there is no such consideration on the macroeconomic level. It is assumed that the optimal allocation on the microeconomic level automatically also leads to optimal allocation and scale on the macroeconomic level. This is, however, not true. Daly (1996) indicates that one could argue that the macroeconomic scale is the result of the aggregate individual willingness to pay. Daly (1996) refuses and points out that the market mechanism does not work like this for environmental resources. The ecosystem is a much too complex system than allowing consumers to grasp what they are willing to pay for and to judge the marginal utility of the resource (Daly 1996:54).

Within microeconomy optimal allocation is one major concern and means efficient allocation of a given amount of scarce resources (Bergh 2001:15). Hence in microeconomics the scale – the amount of resources allotted – is perceived as given. An economic activity only gets uneconomic on grounds of marginal utility considerations, which is also assumed to limit the scale. Scale is hence not directly touched and is believed to be regulated automatically. However, if there is an optimal allocation, leading to optimal scale, there should be an optimal scale on the macroeconomic level as well (Daly 1996:50). Daly criticizes the simple-mindedness of neoliberal economics, stating that “[t]he usual way for economists to deal with the scale issue, when forced to think about it at all, is to try to subsume it under allocation, claiming that if we just get the prices right there will be no scale problem” (Daly 1996:53).

Daly explains that under a cost versus benefits lens, one can realize that there is a certain point when further growth is simply uneconomic. The benefit from increasing the scale is that more economic services are gained; the cost is that this happens at the expense of ecosystem services. Applying the microeconomic logic of marginal utility, an increase in scale leads to rising costs and sinking benefits, thus at a certain point further growth is uneconomic. For Daly (1996) this is the point where an economy is mature and the economic process should shift from mere growth to reproduction and maintenance, from a quantitative to a qualitative process. This state where quantitative progress becomes prior is called steady state economy. The aim is now to enhance the stock and not to increase production and thus throughput (Daly 1996:67).

Daly (1996:55) emphasizes that allocation, scale and distribution are three different things, and that even if the optimal level is measured through costs versus benefits, they need to be tackled in a different way and separately. The market is able to deal with allocation issues, but is not able to deal with just distribution and optimal scale. It is, according to Daly (1996:51, 160), clear for most economists that politics need to deal with just distribution, but so far it is not acknowledged that the same is true for scale. The allocation between shoes and bicycles is an instrumental question. The distribution of wealth and the scale of the economy are not instrumental; they are deeply social. Both ideas about the human being, as the *homo oeconomicus* or a pure social being, do not reflect reality. “We are related not only by a nexus of individual willingness to pay for different things, but also by relations of trusteeship for the poor, the future, and the other species. The attempt to abstract from these concrete relations of trusteeship and reduce everything to a question of individual willingness to pay is a distortion of our concrete experience as persons in community [...]” (Daly 1996:55).

Daly deeply criticizes the apodictic obedience of the allocation function, elevating it to the top of the priority list. As already explained, the allocation function serves the maximization of the efficiency. Daly (1996:51) emphasizes that an efficient allocation does not, however, necessarily lead to justice. He points out that both goals can even conflict with each other, and the market itself is not able to solve this conflict.

Wiesmeth (2012:51) also mentions that environmental protection is connected to justice issues, namely the just distribution of the negative effects of environmental destruction and the burden of protection. Just distribution, also of manmade commodities, is generally a topic of economics, while in contrast to manmade commodities, natural commodities are often excluded from the market mechanism. He adds that just distribution of manmade commodities / capital is influenced by the market mechanism, the initial distribution of the resources and governmental intervention. He again refers to different attitudes concerning the natural valuation and relates it to the costs and benefits the environmental protection brings. The burdens and gains of natural protection and its destruction should be distributed fairly. The market system reflects economic agents' preferences, and since there are differing preferences concerning environmental protection, a just distribution is problematic to be reached through market means. Wiesmeth (2012) argues that there is no possibility to aggregate this preference to reach an acceptable solution to this problem. Therefore he states general equilibrium theory is focused on efficient allocation, rather than distribution.

The same is true for sustainable scale. Daly (1996:51) points out that within microeconomics there is no market feature that reacts to changes in scale relative to the ecosystem. This is because allocation is microeconomics, while scale is macroeconomics. “Ecological sustainability of the throughput is not guaranteed by market forces. The market cannot by itself register the cost of its own increasing scale relative to the ecosystem” (Daly 1996:32). Gowdy and Olsen (1994:168) also refer to the allocation problem. This is that market decisions are taken without taking the absolute scarcity into account. There is no consideration about the maximum optimal consumption or production, except to those regarding marginal changes, thus utility. “Price measure relative scarcity and guide us in keeping everything in the right proportion relative to everything else – but there is no recognition of any absolute scarcity limiting the scale of the macroeconomy” (Daly 1996:27). Gowdy and Olsen (1994:169) point out the fact that neoclassical theory does not offer a framework for how to integrate the scale issue. Exactly these issues are of substantial importance for environmental problems.

Concerning non-renewable resources and intergenerational distribution, the issue is again different. Renewable resources can be used in a sustainable way, consuming only that part that can be reproduced within the same period of consumption. However, with non-renewables this is not possible. So there is an implicit decision of allocating a commodity to either present or future generations. It is presumed in economic theory that the market price is determined through supply and demand. The demand is in analogy to the utility of individuals. Hence present day living individuals communicate their present demand to the market, which, together with the supply, leads to a certain price. There is no problem with one person deciding that he or she might prefer consuming the good now or later. But the present day living individuals also make this decision for individuals not yet participating in the market. No one knows what preferences and needs (beyond the physical basic needs) these individuals will have (Martinez-Alier 1987:156). Assuming the same market conditions for all time, equal right to weight on the different generations' demands would be attached. Why should future generations have more right to consume a good? “Economic theory abhors moral principles” (Martinez-Alier 1987:156). It merely deals with the most efficient allocation of commodities, of the quantities that are traded and the involved prices. Economics does not deal with the physical characteristics of commodities, nor the reason for their demand. Demand obscured behind the magic concept of consumer preferences is determined through physiological needs and cultural and symbolic needs and wants (Martinez-Alier 1987:156f.).

“It is clear that scale is not determined by prices, but by a social decision reflecting ecological limits. Distribution is not determined by prices, but by a social decision reflecting a just distribution of the newly created assets. Subject to these social decisions, individualistic trading in the market is then able to allocate the scarce rights efficiently” (Daly 1996:53). Therefore for Daly (1996) first the proper scale needs to be defined, than just distribution needs to be assured and only at the end should the allocation function of the market step in (see also Müller 2001:434, Mauerhofer et al. 2013).

6.1. Critique concerning the market system

Ecological Economics does not strive to reinvent the wheel, hence some economic concepts like demand and supply remain valid also under an *Ecological Economics* context, since the preanalytic vision differs in its focus, which is mainly due to the rejection of the growth paradigm, the role of allocation and the emphasis on absolute scarcity (Daly 1996:197).

6.1.1. Utility

Another issue is utility, which underlies the market system. Common and Stagl (2005 7ff.) argue that from the basic assumptions concerning utility theory there are not many differences between *Environmental* and *Ecological Economics*. Both include the theory of utility and for both utility is applied from an anthropocentric point of view. However, concerning ethical considerations for *Ecological Economics,* individual preferences are not the only moral benchmark. Another difference is that considering overall welfare, which is the summarized individual utilities, for *Ecological Economics* equity is more important than efficiency. This was already outlined above discussing Daly's scale – distribution – allocation ranking. So the normative justification according to *Environmental Economics* is merely based on the individual perception of pleasure and pain, while for *Ecological Economics* the normative base is the notion of strong sustainability. This diverging source of normative reasoning also affects considerations on the aggregate level. For *Environmental Economics* efficiency is vital, hence equal distribution of utility subordinates the efficiency of the overall system. In contrast, *Ecological Economics* cares about marginal utility differences. One additional Dollar for someone who has less has a higher marginal utility,[15] as someone who has comparatively more will gain less getting an additional Dollar than one who has less (Daly 1996:84f.). Hence ethical considerations underlie the normative base of *Ecological Economics* (Common / Stagl 2005:8ff.).

Venkatachalam (2007:552) points out that the difference concerning the perception of utility refers

15 Utility in relation to happiness and income will be discussed later (see beyond GDP).

to the nature-economy relation. For *Ecological Economics* nature forms the basis of human existence and is hence also the source of enhancing and improving human wellbeing. Given the acknowledgement of absolute scarcity and the negation of nearly infinite substitution of production factors, enhancing the environment has a much higher priority than it has for *Environmental Economics*. Therefore nature must be preserved in order to maintain its utility. Environmental destruction and pollution counteracts this overarching goal and should thus be avoided. In contrast to Common and Stagl, Venkatachalam (2007:552) argues that *Ecological Economics* does also consider the intrinsic value of nature, hence *Ecological Economics* does not only apply an anthropocentric point of view. *Environmental Economics,* in contrast, only deals with the environment's utility to human beings in order to increase their welfare. This is a major difference between the two schools of thought. The latter only cares about nature's value to humans; the former also cares about nature's intrinsic value, apart from an mere anthropocentric point of view. One can argue that at the end of the day *Ecological Economics* also follows an anthropocentric perception, since the importance of the environment is acknowledged due to the actual or potential usefulness of nature as the ultimate life-providing and sustaining power. However, the precautionary[16] notion that this contains still leads to a much broader idea of utility that does not necessarily have to be defined by a direct utility relation.[17]

The Millennium Ecosystem Assessment (MEA 2005:58) also points out the problem of utility, the market mechanism and the effects on environmental protection. "Although most or all biodiversity has some economic value […], that does not mean that the protection of all biodiversity is always economically justified" (MEA 2005:58). The economic mechanisms lead to the competition between utility and biodiversity. "Ultimately, the level of biodiversity that survives on Earth will be determined not just by utilitarian considerations but to a significant extent by ethical concerns, including considerations of intrinsic values of species" (MEA 2005:58).

Apart from anthropocentric versus intrinsic reference framework, the economic agent's behavior[18] also plays a crucial role. Asafu-Adjaye (2005:11) states that neoliberal models are based on the assumption of humans being rational agents that only strive to increase their utility. Usually the assumption is that economic agents direct their utility gains to their own benefit, which must not be

16 The precautionary principle entails not undertaking actions which could threaten others, now or in the future. This precautionary principle grows out of ethical considerations (Friends of the Earth International 2001:9).

17 Later the concept of ecosystem services will be discussed. From the different definitions, one can also distinguish those that put a stronger emphasis on indirect services (supporting services) and those which do not focus on them. This is illustrated comparing MEA's and TEEB's classification of ecosystem services.

18 Van den Bergh et al. (2000:94f.) present a list of shortcomings of the utility maximization theory. They also come up with alternative theories concerning consumer behavior.

the case. “Although there is nothing in economics that requires motivations to be of the self-interest variety, it remains the case that economists have themselves contributed to the fallacy that economic man has only selfish motives”[19] (Pearce 2002:67f.). Neoliberal economic theory labels the economic agent *homo oeconomicus*, who is characterized by full knowledge, and thus the agent can act properly on the market. Rees (2001:1ff.) also criticizes the characteristics of human beings assigned by the neoliberal system. He indicates the failure of this concept to reflect community (see also Borgström Hansson 2003:117ff.) Van den Bergh (2000:48f., Heinzelring / Ackerman 2002:14) moreover, points out that individuals do not only have one point of view, but several, depending on the reference system he or she refers to. One might, for example, have a different opinion acting as individual or as citizen. Accordingly, O'Neil and Spash (2000:8) emphasize that “[g]iven the limitations of the economic assumptions about the agent, policy needs also to be informed by philosophical, psychological and sociological understanding which offers a richer model of the agent.”

We just need to think about ourselves and find out that these characteristics are indeed not correct. The basis for consumers' choices is also questioned. It is generally assumed that consumers' decisions are guided by selfish maximization of pleasure (utility), which is featured by the indifference of the economic agents (see BOX 1) (Gowdy / Mayumi 2001:224ff., Gowdy / Olsen 1994:162).

It has been shown that consumer choice is not as theory suggests. Therefore Venkatachalam (2007:552f.) argues that economists should concentrate more on behavioral patterns of human beings to get a deeper understanding of consumer choice. Research concerning (bounded[20]) rationality, for example, shows that humans often do not decide following an unbounded rationality, which would be merely striving for maximization of utility. If this is true, then the neoclassical models which are based on this rationality are wrong. Bergh (2001:16) points out that in contrast to *Environmental Economics*, *Ecological Economics* prefers to use the bounded rationality approach. However, Venkatachalam (2007:552) argues that behavioral studies would enrich both concepts since the base of human action is important for the economic models. Van den Bergh et al. (2000:44) criticize that although ecological economists do not favor consumer choice theory, they could not come up with new insights explaining consumer behavior.

19 It is a fascinating thought that economics trying to explain human behavior is found to interpret human behavior as being guided by pure self interest to maximize his or her utility, which eventually became a rule and a kind of code of conduct. Thus even if it was not the case, more and more people are *forced* to follow this code of conduct (Ferraro / Pfeffer 2005).

20 For a definition see Van den Bergh et al. (2000:51)

Gowdy and Mayumi (2001:224) point out that especially due to the increasing use of environmental valuation methods (like contingent valuation,[21] explained below) consumer choice theory again became the focus of economic science. Similar to the preanalytic vision and the circular economic system, the theory of consumer choice theory is an oversimplification of reality, describing human beings as “gluttonous single-minded consuming machines” (Rees 2001:1). If this oversimplification in the end leads to a wrong or biased picture, the conclusions drawn from this theory are also wrong or biased (O'Neil / Spash 2000:4). Gowdy and Mayumi (2001:224ff.) explain that the way human cognition was understood from the 16th century onward does not conform to more recent findings. Fundamental assumptions like invariance of preference, indifference or non-satiation are proven to be wrong (Gowdy / Olsen 1994:162f.).

> In neoclassical utility theory, only individual perceptions count. There is no social, biological or physical reality outside the individual, only the subjective feelings of unconnected utility maximizers. The methodological individualism of consumer choice theory systematically ignores the hierarchical nature of social and ecological systems when preferences and utility are aggregated within social systems (Gowdy / Mayumi 2001:231).

Non-satiation is, for example, criticized by *Ecological Economics*, since the precondition for non-satiation, the infinite supply of commodities, does not coincide with the biophysical reality (Gowdy / Mayumi 2001:227).

Gowdy and Mayumi (2001:225) state that probably the greatest shortcoming of consumer choice theory is the commensurability of values. This means that all values are seen as exchangeable. Again reflecting about ourselves, we immediately realize that this is not the case, since there are some commodities that we need for survival, commodities that satisfy our basic needs. As long as these basic needs are not satisfied, other goods that are not necessary automatically are lower in value. This issue refers to lexicographical ordering (Van den Bergh 2000:52) and to incommensurability, which will be further discussed below (Gowdy / Mayumi 2001:229ff., Van den Bergh et al. 2000:53).

It was already explained that *Environmental Economics* tries to minimize negative impacts on the environment owing to economic activity. It is argued that by internalizing, thus attaching a price on external environmental commodities, the economic agents get an incentive to diminish environmentally harmful behavior. The theory behind this is based on the theory describing the behavior of the *homo economics*. His or her choice is said to be steered by prices and income and profit. Rising prices due to internalization should give the economic agent an impulse to reduce these costs and thus reduce, e.g., pollution. Through these simple relations consumer behavior is

21 It terms a range of methods that allow the identification of prices for commodities that are not traded on the market.

predictable and can be influenced as desired. Now it was criticized that consumer choice theory is an oversimplification, leaving many blind spots. If consumer choice is not only influenced by prices and income, not only the predictability of consumer behavior is not given; moreover, the whole economic theory building on it is affected. Thus the idea of internalization and its intended effect in reality do not follow the theory (Van den Bergh et al. 2000:55).

6.1.2. Scarcity

Not only the *Environmental Economics'* approach to utility can be criticized, but also the one concerning scarcity. *Ecological Economics* has a completely different understanding of scarcity, which is due to the acknowledgement of the biophysical reality. One of the main theories underlying *Ecological Economics'* conceptions is the laws of thermodynamics (mainly the second thermodynamic law, which will be discussed below). Due to the biophysical realities and the laws which they obey, *Ecological Economics* emphasizes the prevalence of absolute, rather than relative, scarcity (Venkatachalam 2007:553). This implication also explains why for *Ecological Economics* all resources or generally the environment is considered in economic analysis. It was already pointed out that *Environmental Economics* only calls for the inclusion of environmental commodities when they are perceived as being relatively scarce and that any kind of commodity also scarce in an absolute sense is not taken into account.[22] This neglect of absolute scarcity can be reasoned with history (Costanza et al. 2013:126). Boulding's (1966) spaceship earth essay presents the issue in a nutshell, explaining the history of human impact on the environment by the metaphor of a cowboy on the Great plains versus an astronaut in a spaceship. In earlier times human impact on the environment was comparatively small related to the population size and the whole ecosystem. Now that the population number is much bigger, the effects are no longer negligible. *Ecological Economics* reacts to this fact, while *Environmental Economics* remains stuck in historic perceptions.

Venkatachalam (2007:552) also points out that for *Environmental Economics* natural resources only need to be integrated into the economic logic if the resource is relatively scarce. Moreover the resource must be able to provide utility to producers and / or consumers. *Ecological Economics,* in contrast, does not make this differentiation and treats all resources as equally important.

22 Harold Barnett illustrates the difference between absolute scarcity and relative scarcity. He explains that there is indeed an absolute scarcity, but that this does not mean that this scarcity is experienced in economic terms. As long as the relation of (absolute scarce) natural resources to labor and capital input remains within certain limits, natural resource scarcity is not experienced. Hence “[t]o be economically scarce, the fixed natural resources must be of small amount relative to L + C and the socio-technical parameters” (Barnett 1960:433).

This relative scarcity concept is opposed by the absolute scarcity concept employed by *Ecological Economics*. They moreover emphasize the strong sustainability concept, hence promoting a complementary rather than substitute approach. They acknowledge the complexity of the system and irreversibility and since natural resources are the base for human existence, nature should be protected through regulations and standards, rather than economic valuation based on utility assumptions (Venkatachalam 2007:554).

The relative perceived scarcity approach has another major drawback, which is human perception. Let us suppose that it is sufficient to protect those environmental commodities that are relatively scarce to prevent environmental degradation which would have negative effects on human wellbeing. The tricky thing is, however, that humans have far from perfect knowledge. Hence there might be many relatively scarce resources that from an anthropocentric point of view should be protected, but we do not know about their scarcity and / or their importance to human beings (Wiesmeth 2012:45f.). So even if we neglect the absolute scarcity which calls for the application of the precautionary principle, the uncertainty surrounding perceived relative scarcity should also entail the application of the precautionary principle.

Bergh (2001:15) points out that the analysis of how to gain sustainable growth is done through abstract models, which do not refer to reality or historic context. The question of absolute scarcity and thus a real limit to growth is not seriously taken into account.

6.1.3. Value and Commensurability

From what was explained so far we now know that the market price of a commodity is determined by utility and perceived relative scarcity. It was pointed out that both conditions can be contested. First, utility is not the only factor influencing the value of a commodity and even if so, *Ecological Economics* opposes merely relying on utility when we are faced with questions concerning value and ethics (O'Neil / Spash 2000). Another difference relates to scarcity. *Ecological Economics* more or less perceives all resources as equally important, not differentiating between resources that are relatively scarce and those that are perceived as being abundant. It was explained that *Ecological Economics* understands that all resources are absolutely scarce; nothing is unlimited. Moreover, the uncertainty concerning the whole ecosystem – how which part, factor or component influences others – results in a more general application of the precautionary principle. The substitution of one component by another is contested and in several cases it is more than clear that there is not an adequate substitute. Consequently, the translation of value into one single unit and the commensurability of matter is challenged (Gowdy / Mayumi 2001:229).

Venkatachalam (2007:553) points out that in contrast to *Environmental Economics*, *Ecological Economics* derives value from mere existence. Martinez-Alier (1987:87ff.) criticizes the mechanistic point of view that orthodox economics follows. He opposes Jevons' mechanistic idea about value, as well as Walras'. From these ideas one could claim that there is no universal value, no value apart from the one determined by utility.

Martinez-Alier (1987:69ff.) explicates that the intellectual fathers of *Ecological Economics* like Sacher, Podolynskyj or Geddes concentrated on the value question. In contrast to orthodox economic theory, they tried to relate value to the biophysical reality, to input-output considerations. The basic idea was to analyze how much energy and / or matter is needed to exploit, transform and transport a commodity. This can be compared with the energy and / or matter gained at the end of the process. The energy and matter that is lost during this process is in orthodox economy often not included and only the final product is valued. Such calculations illustrate that the output is smaller than the orthodox economic input-output calculations show. Martinez-Alier argues that only the energy that is received at every step of “production” is being paid for and not the losses of the potential energy. “The final product was not 'added' value at all; it was the value remaining from the energy and materials available at the beginning once they had been through all the stages” (Martinez-Alier 1987:95).

However, Martinez-Alier (1987:71) points out that not all value can be explained with energy or matter input-output calculations (e.g., the value of arts). Skills and innovations are also very important for production efficiency, but cannot be expressed in energy flow calculations.

Martinez-Alier (1987:90f.) refers to Geddes, who criticized the utility concept due to its lack of objectivity, from which it follows that utility is no universal scientific factor. He states that unmasking the generality and comparability of the utility concept “[...] can be seen as objections to the commensurability of consumer goods in economics [...]” (Martinez-Alier 1987:91).

Martinez-Alier (1987:158) suggests the imperialism of economics with its assumption of universal commensurability, which is everything can be valued in monetary terms.

> The economics makes the assumption of commensurability between things which are, perhaps, incommensurable from other points of view, comes out clearly in such studies, which push to the limit the principle of subjective valuation. We are asked to accept that, political leaders' assessment of the rationality of trade-offs between millions of deaths and territorial consequences (or political gains), has something in common with the trading-off, in elementary micro-economics, of apples and pears on an indifference curve. (Martinez-Alier 1987:158)

Van den Bergh et al. (2000:53) explain that incommensurability expresses the attitude that it is

impossible to translate different characteristics into one single unit. The authors point out that this implies not only the rejection to translate everything into monetary terms, but also in every other unit, including biophysical units. They refer to Martinez-Alier, who emphasized that *Ecological Economics* does not want to exchange one pablum with another one.

“Ecological economics does not propose a new theory of value: it questions commensurability, whether in terms of prices, calories or production time” (Martinez-Alier 1987:148). It also opposes translating everything in calories to calculate input-output models concerning energy throughput. Such a unit does not differentiate the source of energy, like renewable or non-renewable energy. In the sense of income, only the amount produced within a year should be consumed. Since non-renewables, like coal or oil, take very long to be produced by nature, from such sources much less should be taken than from renewable sources. As just stated, a simple caloric unit does not unravel such differences, thus it also cannot comprehensively illustrate sustainable resource use (Martinez-Alier 1987:147f.).

That Martinez-Alier (1987:188) pointed out the importance of the source of energy and matter illustrated that this has two major implications. First, it indicates the idea of strong sustainability; hence, it is not assumed that one source can easily be exchanged with another one. Second, the implications concerning fair intragenerational distribution that is not ensured by the market mechanism. “But the market price of coal or oil and the resulting allocation of resources are firmly embedded both in the interpretation of physical reality that economic agents take from the history of science and technology; and in the social distribution of moral values concerning the demands of future generations” (Martinez-Alier 1987:188).

Martinez-Alier (1987:180) generally criticizes that concerning future demand or externalities, individual preferences should not be the basis for decisions. Rather “[...] *we* have to give values to the preferences of *other* unborn individuals.”

Hardin (1968:1244) also refers to the problem of incommensurability, but he states that actually there is a way how to make things commensurable: weighing. He points out that in nature the value of things is distributed according to their necessity to allow survival. “Natural selection commensurates the incommensurables” (Hardin 1968:1244). Hardin states that we should adapt a similar framework for weighing. However, finding an acceptable framework will be a difficult task. It has to be pointed out that incommensurability does not mean incomparability. It is just weak comparability (Martinez-Alier et al. 1998:280).

Environmental valuation is a highly ethical question and many ecological economists would probably rather abstain from such activities. Still, some are engaged in environmental valuation. One reason might be that humans make valuation, even if they are only implicit. Making them explicit transfers the value of environmental commodities from obscure to visible. It is a means reflecting people's implicit thinking (Costanza et al. 1997:255). Moreover, nowadays translating value in monetary value seems to be the only tool making it understandable.

6.1.4. Basic assumptions for the proper functioning of the market system

One overall critique of the underlying concepts of *Environmental Economics* is summarized under the term misplaced concreteness (Borgström-Hansson 2003:111ff.). This basically means that the models on which *Environmental Economics* is based on constitute abstractions of the reality. The problem starts when economists forget the limits of such models and take them for real.

> The neoclassical theoretical framework of environmental economics not only allows its proponents to simplify and reduce a complex reality on the basis of a few quite debatable assumptions. What is more, the results of coming out of this simplified model are not tested against an empirical reality. Instead, they are verified with reference to the theoretical model itself [...] (Borgström-Hansson 2003:112).

The functioning of the market system is also contested. For example, Pareto efficiency is believed not to work under real conditions. This regards governmental intervention, which leads to market distortions and thus distortion of the optimal working of the market mechanism (Gowdy / Olsen 1994:164f.). On the other hand, *Ecological Economics* promotes governmental intervention. In neoliberal theory the role of governments is minimized because government intervention would lead to market imperfections. The control is handed over to international operating companies, which do not have responsibility or accountability to the people (Rees 2001:1). As Daly (1996) pointed out, the inability of the market system to solve environmental problems indicates that governmental intervention is needed. Daly states that the market can merely solve the allocation problem, but it can solve neither distributional nor scale issues (see for example Stavins 2007:8f.), hence intervention is required (Daly 1996:14ff.).

Borgström-Hansson (2003:113f.) also discuss the Pareto efficiency, stating that real existing property rights diverge from what is assumed in theory. Accordingly the theory of Pareto efficiency is questionable. Moreover, allotting property rights of every environmental commodity to individuals has serious ethical implications. Apart from this, the already existing distribution of property rights is very uneven, which also affects the result of Pareto efficiency. Such distributional issues are, however, not taken into account by neoliberal theory.

Gowdy and Olsen (1994:165f.), for example, state that they do not want to downplay the role of

neoliberal theory and its positive contributions, but they point out that the model has serious shortcomings in using it for the solution of environmental problems: a) discounting, b) marginal change, and c) perfect information.

Another wrong assumption concerning markets is that of “general competitive equilibrium” and the assumptions about the conditions that allow such an equilibrium that are not fulfilled in reality (Rees 2001:4f.). Müller (2001:424f.) points out that introducing future uncertainty into the standard model results in malfunctioning of the model. The problem is basically related to humans' limited cognitive abilities. Müller (2001:424f.) concludes “[…] once a realistic concept of uncertainty is introduced, the model becomes valueless. Thus, the model of competitive equilibrium is in the economic profession one of the most favorite fictions.”

One can also criticize that the market mechanism only functions if there is no economic agent that can influence the price (Wiesmeth 2012:47). However, it is questionable whether this condition is fulfilled in reality.

Another major criticism regarding the market system relates to the assumptions concerning the *homo oeconomicus*. Müller (2001:421f.) points out that the assumed rationality can be contested, since it is indeed difficult for humans to really grasp the importance of particular environmental commodities and make rational trade-offs between different options. Moreover, as already indicated, valuation of different environmental assets differs substantially due to education, ethical attitude, moral concepts, culture, etc. Apart from this, uncertainties concerning the effects of actions limit the power of rationality. Another aspect is that the sum of individual actions is more than just the sum of single decisions, but rather a complex societal system (Müller 2001:422).

7. The production function and the IPAT identity: technology and financial capital as facilitator of unlimited economic growth

The production function is a function of the components (inputs) needed to produce a commodity. In contrast to the behavior of the consumer, the producer's incentive is to maximize profit, thus the input-output ratio needs to be maximized (Asafu-Adjaye 2005:49). The *Cobb-Douglas*[23] function is a commonly used function in macroeconomics. One prominent example where this function is employed is the United Nations Environment Program (UNEP) Green Economy Report (GER). The calculations of the UNEP's GER (2011:Box A1) are based on the *Cobb-Douglas* production

23 For the history of the evolution of the function, see Douglas (1976).

function.[24] The production function is, together with the savings function, a means to explain the conditions for economic growth. The production function determines national income (Y) through capital (K), labor (L) and resources (R). The parameters α, β and γ add up to 1 in order to produce constant returns to scale.[25] Moreover, they indicate the share of the respective input to the national income. Thus the function illustrates the respective contribution of the three input categories to the national income (Common / Stagl 2005:173ff., see also Douglas 1976). Another assumption is that the production factors K, L and R are nearly infinite substitutes.[26] Therefore one can get the same level of income (output) with different levels of input. This means that, for example, labor or capital increases, while resource input keeps stable, reaching the same result for income (Daly 1996:48, Common / Stagl 2005:175, 219ff., Kuznets 1960:230ff.).

Now this becomes important for *Environmental Economics*, since one can compute scenarios examining future GDP growth, increasing financial capital inputs and lowering natural resource inputs. Common and Stagl (2005:174ff.) illustrate clearly what role especially capital and technological innovation, increasing efficiency, have in order to allow perpetual economic growth.

Cobb-Douglas function:

$$Y=K^{\alpha}*L^{\beta}*R^{\gamma}$$

Pearce (2000) interprets economic growth theory as a means to gain sustainable development. Merging economic growth with the concept of sustainability, he states that economic growth is sustainable when per capita wellbeing (utility) rises sustainably over time. He uses a sustainability concept in line with the *Cobb-Douglas* production function logic. The capital necessary for building and enhancing wellbeing is perceived as being substitutable, hence the overall amount of the different capital types[27] has at least to remain constant. This means that when, e.g., natural capital stock is drawn down it has to be compensated by one of the other capital types. The condition of sustainability, however, still demands that every generation at least leaves the same overall amount of capital assets to the next generation. In order to calculate an "optimal path of

24 The application of the Cobb-Douglas function to the UNEP GER will be examined later
25 Output increases to the same proportion as inputs do.
26 See in contrast the Leonthief production function, which does not allow substitution (Common / Stagl 2005:221, Daly 1996:77).
27 Social capital, financial capital, natural capital, built capital. (Costanza et al. 1997:254, Costanza et al. 2011)
"Social capital is defined as the social connections and the attendant norms and trust and reciprocity that enable participants to act together more efficiently to pursue shared objectives. It facilitates collective action" (Ananda / Herath 2003:350).
Costanza et al. (2013:128) argue that financial capital is not a capital, since it is only a means to communicate the value of real capital)

consumption", Pearce employs a function containing the *Cobb-Douglas* production function. In order to keep on a sustainable track, Pearce emphasizes the role of technological innovation, increasing the resource use efficiency. Similarly, Common and Stagl (2005:235) point out the importance of technological innovation allowing unlimited economic growth. "Technological change has the potential to rescue optimal growth paths from being unsustainable" (Pearce 2002:63).

7.1. The IPAT identity

The IPAT identity is another important equation that explains why technological innovation is so important for *Environmental Economics*. The IPAT identity illustrates that human impact (I) on the environment is determined through three different variables. The first one is population number (P). It is clear that the more people on the planet, the more consumption and resulting pollution will take place. "A" stands for affluence, which refers to the level of consumption. Finally, "T" represents the technology employed (Common / Stagl 2005:210f., Ness / Golay 1997:62. Alcott 2012:109, Alcott 2008:781, EUROSTAT 2002:45). Generally, it can be stated that the "T" variable is the most important one for *Environmental Economics* (Alcott 2008:771).

7.1.1. Population number

The IPAT identity allows the calculation, for example, considering "A" and "T" remaining the same, of how population growth will affect mankind's impact on the environment (Common / Stagl 2005:212f.). It is clear that if the other two factors stay the same the impact has to rise. This means it would be one option in order to stabilize society's impact to reduce or at least stabilize world population number. Reducing population number is, however, not an issue for *Environmental Economics*. Wiesmeth (2012:22f.), for example, has no chapter on population growth; he only refers to India when he touches on this issue. His recommendation is not to reduce population growth; he rather states that in order to minimize greenhouse gas emissions (GHG), India should invest more in renewable energies. Indeed, shifting from fossil fuel carriers to renewable energies is necessary; however, neglecting the population issue exemplifies environmental economists' trust in technological innovation. Another example is UNEP's GER (2011:15), where population growth is also not really dealt with. Again, the role of technological innovation is emphasized.

One of the reasons why for *Environmental Economics* introducing policies to stabilize or reduce population number is neglected can be found in the assumption that more people allow more innovation (Coccia 2013, Kutznets 1960). Coccia (2013) states that even though in economic science diverging findings about the relation between population growth and innovation exist, the majority of results indicate a positive correlation between the two. The innovations can in turn help offset the negative effects of population growth. The other reason not to intervene in population

growth is the belief in the effect of technological innovation on the population growth rates. It is assumed that technological innovation leads to a transition from quantity to quality. A kind of “virtuous circle” can be described, with an ever-decreasing birth rate together with higher education of the offspring, who again increase the potential for technological innovation (Galor / Weil 2000:810f.). But not only technological change can be interpreted as acting beneficial on birth rates; income growth is also perceived as a positive influence (Barnett 1960:436). Ehrlich and Kim (2005) found that whether birth rates decrease before or after technological innovation depends on the source of the respective technologies. If it is, for example, a life-enhancing technology, population is very likely to rise before it falls (“population transition”, Eswaran 1998:238).

Kuznets and Boserup are two of the most prominent representatives advocating the positive relation between population growth, economic growth and increasing innovation (Coccia 2013, Turner / Shajaat Ali 1996:14984, Kuznets 1960:324ff., Boserup 1983:384).

Kuznets[28] (1960:324ff.) opposed the negative Malthusian point of view that population growth has only adverse effects on society and economy. Although he does not deny the problem of resource shortage, he points out the positive aspects. A greater population number means a greater labor force. Given that they are at least equipped with the same (or greater) amount of reproducible capital as the previous smaller generation and that the output ratio remains at least the same, they will be able to produce more and hence promote economic growth. Even if resources get scarce Kuznets points out that these resources can be substituted by more manmade capital and / or technology. To allow an increasing productivity, capital needs not to only be invested in material goods, but also in human capital, increasing education and thus raising the proportion of skilled and trained people that can spur technological innovation and output productivity. Moreover, Kuznets points out that increasing population numbers might also have positive effects on the savings rate and on consumption.

Similarly, Boserup (Pender 1998:100, Ananda / Herath 2003:345, Boserup 1975, Turner / Fischer-Kowalski 2010) found that increasing population pressure on land leads to agricultural intensification and technological innovation. Although research results on the influence of population pressure on the environment vary, examples illustrating the positive effect resulted in defining an inverted U-shaped relation between population growth and natural resources. For Boserup's theory to work, scarcity of land is a precondition. Increasing prices for land-based

28 Kuznets' remarks are followed by critical comments from Richard Quant and Milton Friedman, both of whom emphasize the issue of resource shortage. The chapter written by Harold J. Barnett *Population Change and Resources: Malthusianism and Conservation* illustrates the atmosphere of the time, in which Kuznets (but also Boserup) postulated the advantages of population growth.

products, increasing demand due to population growth and hence following a “necessity is the mother of invention” attitude, people have an incentive to change their land management (Ananda / Herath 2003:345).

However, it has to be emphasized that the positive effects of increasing population numbers are bound to several conditions. Assuming the substitutability of capital stocks, probably the most important is that the capital stock is large enough to guarantee investments. Therefore Kuznets (1960:337) argues that the positive aspects of a growing population can rather be canalized in the developed world.

Kuznets (1960:339) acknowledges that the negative aspects of population growth have generally to be weighed against the positive aspects and that neither too much population growth nor too little is good for a society. Coccia (2013) tested whether there is a relationship between population growth rates in OECD countries with technological innovation (measured through patent applications). He found that Kuznets' prominent theory about the relation between economic growth and just distribution can also be applied to the relation between population number and technological change. He illustrated that there is “[...] an intermediate area of population growth rates […] favorable to support technological output growth [...]”. Coccia (2013) concludes that there is no linear relation between population growth rates and technological innovation, but one that is shaped like an inverted U. Thus he supports Kuznets’ assumptions outlined before.

The importance of technological innovation offsetting rising population numbers with fixed natural resource stocks is pointed out by Kuznets or Barnett already in the 1960s (Kuznets 1960:325, Barnett 1960:434). Both authors try to give arguments opposing the pessimistic Malthusian world view, indicating the limits to growth due to natural resource limits. This illustrates that by this time the trust in technological innovation finally leads to the rejection of the limits[29] to growth idea (Bloom et al. 2001:9f.; see also Mursa 2012). Pender (1998) combines Boserup's optimistic theory where population growth improves land management with Malthusian pessimism concerning fixed resource availability. He indicates that the negative effects of population growth can be overcome through technological and institutional innovation. Again, financial capital is amongst other factors crucial in order to provide a good basis for investment and innovation. Moreover, he points out that environmental degradation does not necessarily have to be caused by population growth but rather by market conditions[30] (Pender 1998:103, Ananda / Herath 2003:347).

29 Mursa (2012), for example, generally negates resource scarcity and thus completely rejects a Malthusian point of view.

30 This relation was already mentioned above, in the “Externalities” section referring to the prisoner's dilemma, which means that consideration following the logic of the market mechanisms may also lead to

Although it is assumed that technological innovation can mitigate the negative effects of population growth and although moderate population growth is seen as an engine for economic growth, it is generally acknowledged that too high population growth rates have negative effects on economic growth (Coccia 2013, Dao 2012). Also too low population growth has negative impacts[31] (Coccia 2013, Goldstone 2010), which is why Goldstone (2010) states it is rather the distribution of population than population growth *per se* that is important. Aging of the population, thus the loss of productive work force and consumers, might constitute a severe problem for the developed countries and in the future also for developing countries (Goldstone 2010, Lee 2003, Bloom et al. 2001).

Given what was discussed so far, in order to control population growth in developing countries the leverage is economic development,[32] rather than direct control of birth rates (Alcott 2012:111). The aim is to support a demographic transition which was experienced by western countries from the beginning of the Industrial Revolution onward (Eswaran 1998). Lee (2003) states that even the Least Developed Countries already started this transitional process. However, the question of how far and how fast remains.

Concerning the IPAT identity reducing population growth and keeping the other variables, the same would not be enough to reduce humanity's impact. Alcott (2012:109) even mentions a kind of rebound effect concerning lower population numbers. This means that if population number decreases and affluence increases, the impact is unchanged. Thus reducing the impact through better technology, hence increasing resource use efficiency and changing production and consumption patterns, is probably more influential than starting with population (Alcott 2012:109f.).

7.1.2. Consumption and production patterns

Affluence in the IPAT identity points to the relation between GDP and GHG emissions.[33] An increasing GDP also leads to an increase in GHG emissions (Common / Stagl 2005213f.). The reason for this is that people having more money at their disposal will consume more. Within

environmental degradation.
Moreover, there is no clear evidence whether population growth has positive or negative effects on the environment. Both can be observed (Ness / Golay 1997: 41, Nkonya et al. 2011:66).

31 Elgin and Tumen (2012) illustrate that economic growth is possible even with declining population.

32 Boserup (1983:403ff.) draws from an historical analysis the negative impact of food imports to developing countries. She indicates that the failure to invest in rural areas in order to improve output and thus not being dependent on external food inputs has enormous negative long term effects on development. Hence it is not the increasing demand that makes up the major problem; rather, it is the lack of independent adaption to the new situation.

33 Or whatever environmental indicator is chosen.

neoliberal economy as well as *Environmental Economics*, lowering consumption is no option, since this would slow down economic growth. And as economic growth is seen as being fundamental to achieve society's wellbeing, reducing affluence is not an option (Lintott 1998: 241). The only way to decrease the effect of “A” is to shift consumption to commodities that have a lower environmental impact. This is why a shift to “greener” consumption is promoted (Lintott 1998: 241 calls it “modified consumerism”). Such a shift in economic activity is captured in the concept of Green Economy. We will have a closer look at UNEP's Green Economy concept below. However, another important factor to reduce human impact is technology, which will be discussed in the next subsection. In short, through shifting production and consumption to greener arrays and increasing resource use, efficiency decoupling is aimed, which means keeping demand stable or even rising, thus keeping GDP stable or even rising, while the environmental impact decreases (Alcott 2008:770).

7.1.3. Technological innovation

Technological innovation is the factor that is most important for *Environmental Economics*. It is believed that technological progress can eliminate at least to a great extent resource scarcity, believing in nearly perfect substitution of production factors[34] (Munda 1997:217, Rees 2001:1ff., Pearce 2002:61, Borgström Hansson 2003:82). Moreover, considering the IPAT identity, technological innovation is the variable that is believed to have the greatest potential in reducing environmental damage. As already explained, population number is not an issue for *Environmental Economics*, and according to the *World Population Prospects* of the United Nations (UNCDES 2011), population numbers will rise to 9.3 billion by 2050 and 10.1 billion by 2100 (medium variant), which will result in rising demand and thus environmental impact. The negative impact of affluence can be limited only to a certain extent, as long as we hold the growth paradigm. Hence technological innovation has a major role in reducing humanity's impact. Technological innovation has an impact on population number as well as consumption. Kuznets (1960:336) argued that technological change, which also leads to new products glutting the market, leads to increasing demand and thus increasing national income. Galor and Weil (2000:810) explain that technological progress affects the demand for higher educated offspring, which leads to higher education and lower birthrates, hence a change from quantity to quality.

The IPAT identity can illustrate how big the contributions of technological improvement have to be in order to meet, for example, emission targets (Common / Stagl 2005:215f.). Improvements in “T” are connected to the effects of “A”, since increases in efficiency or a shift to “greener” production

34 The strong belief in technology can be explained historically. Through technological innovations it was possible to increase population numbers and affluence, which was believed to be impossible before Industrial and Green Revolution (see, for example, Galor / Weil 2000).

and consumption are related to technological improvements (Common / Stagl 2005:216). Common and Stagl (2005:216f.) moreover illustrate that “A” and “P” influence the overall impact; hence if “A” and / or “P” decrease, the overall impact decreases as well. Technology, in contrast, is related to particular impacts, like GHG emission or water pollution. Consequently, technological innovations allow tackling the reduction of particular environmental impacts.

Technological innovation is deeply connected with the production function and the belief in infinite substitution. It was already stated above that it is assumed that as long as financial capital input is higher than population growth, economic growth can be ensured even if resource inputs decline or keep stable. Capital input can be understood as investment in technology, which increases resource use efficiency (Common / Stagl 2005:178, 184ff.). Combining these two equations, we can see that due to infinite substitution, economic growth can be secured even with declining resource availability, thanks to technological innovation. At the same time, the environmental impact of economic growth can be kept stable or even decrease, since technological innovation, enabled through financial capital input, balances and probably even minimizes the harmful effects of the other two factors (“A” and “P”).

The important question is how to increase investment in technological innovation. *Environmental Economics* is based on the assumption that further technological progress will solve problems related to resource shortages. This is in line with the *Environmental Kuznets' Curve* (EKC) theory and thus growth should be promoted to allow a faster technological development (Venkatachalam 2007:554). Another strategy could be to implement standards as incentive for enterprises to develop more environmental friendly technologies that additionally increase production's efficiency (Venkatachalam 2007:554).

7.2. The IPAT Identity an Ecological Economics' point of view

As already stated, the IPAT identity shows the relations between the factors technology, affluence and population number and the influence they have on resource availability. The equation was developed by Paul Ehrlich and John Holden, realizing that the per capita consumption as well as technology can only be a part of the solution but not the whole. If strong sustainability is the goal, then population also needs to be considered (Ness / Golay 1997:62). The section in the *Environmental Economics* part dealt only with two of these factors, while technological innovation is the most important one. That technological innovation is the most important one is due to political reasons. Daly (1996:7) states redistribution and birth control are politically impossible issues, and thus only technology remains.

Principle 8 of the Rio Declaration on Environment and Development (UN 1992) states:
"To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies." There are three issues that I want to highlight that are important for the following analysis. First, not only a shift of production and consumption pattern, but also a reduction is aimed at. A reduction opposes *Environmental Economics'* goals, at least as long as we are talking about an overall reduction in consumption. Moreover, not quantity but quality is the overall goal. The difference between the two will be explained below. Both issues, consumption patterns as well as quality of life, belong to the affluence variable. The other variable mentioned is population number, which will be discussed in the next paragraphs. However, the only variable not mentioned is technology. Anyway, within the Rio Declaration growth is seen as the engine to allow the achievement of the goal of sustainable development. The Rio Declaration is thus a fairly contradictory document. Nevertheless, both variables are of great importance for *Ecological Economics*.

7.2.1. Population number

As pointed out above, *Environmental Economics* do not a negative attitude toward population growth and do not really want to counteract population growth. Rather, it is believed that through economic progress, population numbers will go down automatically (Venkatachalam 2007:555). In contrast to this is the perception of *Ecological Economics* (Pimentel / Pimentel 2006). Their rather realistic attitude is related to the carrying capacity of the environment and the finding that allowing a fair distribution of wealth with more people means that everyone has less than with lower population numbers (Alcott 2012:110, Venkatachalam 2007:555). Indeed, changing consumption and production patterns as well as technological innovations will help reduce human impact; nevertheless, reducing population growth is still vital. Besides the obvious advantage that less people can have a bigger share of the whole, the pressure to reduce human impact through the other two variables ("A" and "T") is smaller (Alcott 2012:110).

Asafu-Adjaye (2005:230, see also Bloom et al. 2001[35]) differentiates between the optimists and the pessimists, while the optimists are the fraction of people that believe in economic growth and technological progress to buffer the negative effects and lead to a decline of population growth. The pessimists always have nature's provisioning and absorptive capacities in mind and thus are not that optimistic.[36] The pessimists date back to Malthus (1766-1834), with his essay *An Essay on*

35 They even distinguish three different types. Apart from the pessimists and the optimists, they also identify the neutralists, stating that population growth alone has not such a huge impact, thus also other factors need to be taken into account.
36 The NBER issue on Demographic and Economic Change in Developed Countries illustrates these two

the Principle of Population, which was written at the end of the 18th century. Malthus postulated that population growth and the subsequent demand for raw material is limited by the available land. The population number will, according to him, be regulated automatically, when a maximum is reached through positive (war or illnesses) or preventive (societal conventions) measures (Asafu-Adjaye 2005:230, Barnett 1960:427f., Galor / Weil 2000:807, Kaack / Katul 2013, Ehrlich / Lui 1997:207f., Lee 2003:169). His hypothesis was amended by Ricardo (1817), suggesting that through increasing world population not only the arable land increases, which is limited, but that also within this process more and more inferior land will be used, which gives less output. This is diminishing marginal productivity, meaning that the absolute amount of output decreases, but with an increasing rate (Asafu-Adjaye 2005:231, Ehrlich / Kim 2005:790). Malthus' perception was even more dire than Ricardo's since he did not even take the possibility of technological[37] improvements into account (Asafu-Adjaye 2005:231, Barnett 1960:438, Galor / Weil 2000:807, Ehrlich / Lui 1997:209).

Trade, the Green Revolution, the application of fertilizers and pesticides, improved irrigation systems and intensification of agriculture allowed increased agricultural production with comparatively little expansion of agricultural land. Therefore Malthus' projections did not come true (Asafu-Adjaye 2005:231, Evenson / Gollin 2003, Pingali 2012, Martinetz-Alier 1987, Galor / Weil 2000:807f., Boserup 1983:384ff., Ehrlich / Kim 2005:804).

Environmentalism[38] can be traced back to the 1960s, where pollution got ever more severe and gave rise to environmental awareness. The energy crises led to the revival of Malthus' theories, and the neo-Malthusian era began (Asafu-Adjaye 2005:232, compare Barnett 1960:423ff.). Already in the beginning of the 1970s the famous report to the *Club of Rome, The Limits to Growth,* attested that humanity is facing limitations due to resource availability. These limitations call for a comprehensive strategy to tackle it. This strategy suggests to stop economic growth, to stop population growth and to stop ongoing pollution (Asafu-Adjaye 2005:232). Daly (1996:107) is very clear on this issue: "In any event, population growth must be stopped as soon as possible." Taking

positions (see footnote No.: 27). Barnett (1960:435), for example, herein points out that it depends on the time horizon taken into account. From a long term perspective overpopulation will always be an issue. On a short term perspective, in contrast, population growth seems not to be such a big problem.

37 According to Malthus technological innovation only leads to increasing population density, but not to increasing living standards (Galor / Weil 2000:807).

38 See also Barnett (1960:440ff.). Barnett refers to an early environmentalist movement at the end of the 19th century. This movement emphasized the absolute resource scarcity as well as the interconnections between resources, hence the ecosystem. Therefore these representatives were aware of scarcity due to dependencies in the environmental system. Moreover it was clear that, due to the different reproduction capacities of the various resources, resources had different features of scarcity. The author also refers to waste, while it is here not understood harmful output of production processes, but as inefficient use of resources.

into account the costs that overpopulation causes, he (Daly 1996:83) states that birth control or family planning is a kind of investment, since such measures would reduce future costs borne by population pressure. However, as Venkatachalam (2007:555f.) points out, compulsory measures to cut back population numbers might neglect the social effects of falling population numbers, especially in developing countries. The author again emphasizes the importance of behavioral patterns that undermine population growth patterns, and that therefore world population should not be seen as a homogenous unit that needs to be minimized. Thus, policies need to be sensitive to the socioeconomic setting (Alcott 2012).

Hardin wrote in 1968 about the problem of overpopulation in a pretty *Ecological Economics* manner. He points to the carrying capacity of the planet, recalling the famous essay of Boulding from 1966, while Hardin did not actually refer to Boulding. Hardin's article did not deal with the connection between economic growth and population growth, although he mentions that due to planet's carrying capacity it is impossible (mathematically and biologically) to maximize both economic growth and population growth. Hardin interprets reproduction in the light of the tragedy of the commons. It is – as it is a Human Right – everyone’s individual right to reproduce him-/ herself without limitations. He thus perceives reproduction as a kind of open access good (see also Alcott 1012:115). Hardin openly criticizes the taboo on the population issue and the inviolability of the human right to reproduction. In the face of planetary boundaries and carrying capacity, this right should be challenged. Discussions about the right to reproduction entail ethical considerations. Hardin correctly points out that whether something is ethically correct or not depends to a certain extent on the circumstances. Considering a code of conduct on how to treat the natural environment, the rules differ depending on circumstances. On an empty planet there might be nothing wrong about individuals littering, since their impact is, in relation to the ecosystem, negligible. As we know, this is not the case today. Most of us know how it looks in our crowded world when everyone throws everything away. Littering can nevertheless be seen as personal freedom. However, for example in my country, Austria, littering is not accepted by society and is even fined. This interference in personal freedom is accepted as a social convention. Following this, it is questionable whether it is unethical to deny people's universal human right to reproduction; rather, the opposite might be the case.

Looking at the population issue from the freedom perspective, overpopulation increases the limits to personal freedom. If everyone has the same right to wealth, then the share everyone gets decreases as the number of people increases. Not only does the share of wealth for everyone decrease, but also freedom. In case one day absolute decoupling will be possible, physical wealth will probably not be such a big problem, but personal freedom will still be (see Hardin 1968:1246).

Moreover, Alcott (2012:115) points out that humans not only have rights, they also have responsibilities. Humans have the responsibility not only to care for each other, but also to care for our planet. Thus the right to reproduction and the responsibility to care clash. It is rather society's constructed standard to prioritize the former than a natural law.

Asafu-Adjaye (2005:232) puts Daly as one of the first scientists who jumped on that bandwagon and proposed a steady state economy that is also linked to the condition of zero population growth. Concerning population growth, Asafu-Adjaye (2005:232f.) refers to Paul Ehrlich,[39] who assumed population growth to be the problem threatening human survival. Furthermore, he (Asafu-Adjaye 2005:233) refers to Georgescu-Roegen, who based his theories on thermodynamics, arguing that zero population growth is not even enough, and that population numbers should be drawn down to a number that allows sustaining the population with organic agriculture alone.

Alcott (2012) analyzes the population issue from an *Ecological Economics* point of view, referring to the carrying capacity of the planet. Similarly to Malthus or Ricardo, he relates the population question to available arable land, the quality of that land, the type of land management and whether this is sustainable, and the ethical implications of food distribution and access. Analyzing literature on these issues, he concludes that lower population numbers are necessary. He further illustrates how the IPAT (or P=I/AT) identity can be used to undergo an intellectual game, finding out how we have to influence the variables when we wish a certain level of impact (or population number). Alcott states that *Ecological Economics* has the tools for such analysis. Following from the results, policy measures can be designed. He moreover states that population number is not given; it is a social choice.

As Hardin (1968:1244) points out, it will be difficult finding a solution to the population problem. Finding the optimal population number entails a lot of research and ethical decisions, which will take more than just one generation. Therefore society needs to tackle the problem sooner rather than later. Neglecting the problem or blindly believing in technological innovations could prove to be a big mistake. Considering natural conditions that influence human decisions, Hardin (1968:1246) moreover states that if the majority of the world population would still directly depend on the environmental limits, the problem of overpopulation would be solved automatically. Newspapers are full of the call for a new agricultural revolution in order to feed an ever-increasing number of people. Isn't it strange that rather than just adapting the number of people to the natural carrying capacity, we are looking for another miracle breaking the chains?

39 See Williams (2008).

Another thing that Hardin (1968:1244) points out is that if Adam Smith's theory about the invisible hand is true, we could go on trusting in the market mechanism and the personal decisions driven by self interest, since they will lead to an optimal state for the whole society. However, if this is not the case we again have to reconsider the political neglect of the population issue. Kelley and Schmidt (1995), for example, show that the relation between population growth and economic growth is not as simple as described by neoliberal belief. Apart from various effects of a population transformation, the effects of a growing population were in the 1960s and 70s rather nil and in the 1980s rather negative. The model developed by Galor and Weil (2000:811) seems to be very logical. They build up Kuznets' (1960) assumptions and come to the conclusion that technological innovation, together with education, solves the problem of overpopulation. However, they assume that without fast technological innovation, parents have little incentive to invest in their children's education. This is hardly the case. The dynamics are much more complex than supposed, not only that in poor regions people are forced to get more children, since they need the labor force and support for their “retirement” (Ehrlich / Lui 1997:215); moreover, they often simply do not have the financial means to invest in education. Kuznets, in contrast to Galor and Weil, applied this idea only to the developed world, where enough capital is available for education. The same is true for Coccia (2013), who calculated his model only for OECD countries. Galor and Weil (2000:826) do indicate that their model might not be applicable for developing countries. However, they argue that this is not due to the lack of financial capital, but rather due to different circumstances like technological imports which make technological innovation no longer relevant for demographic change.

The UNEP report on decoupling (2011[2]) comes up with different findings concerning population number. High population density has positive as well as negative effects. However, it is clear that material consumption rises with rising population number.

Krausman et al. also (2009, see also Behrens et al. 2007:447) illustrate that with rising population number, demand for natural resources rises as well. However, it is not only the “fault” of countries with high population growth rates that natural resource use is accelerated. Industrialized countries exhibit a higher and increasing material consumption per person, thus affluence rises with industrialization. Hence it is one issue to control population numbers; the other is to control consumption.

7.2.2. Consumption and Production Patterns

Compared to *Environmental Economics, Ecological Economics* has a different attitude toward the “A” variable. It was noted that for *Environmental Economics* affluence is only interpreted as shifting

production and consumption to areas where less negative environmental impacts are expected. Something like sufficiency is not an issue for *Environmental Economics*. Again, this means to cut back consumption of wealthy people which would probably lower GDP, which is not desired. *Ecological Economics,* taking into account the finite resource base and not prioritizing GDP growth, aims to reach sufficiency.

Daly (1996:14f.), for example, states that the goal is not only to shift our production and consumption pattern, but to reduce both (see also Daniels 2010:955f.). According to Daly (1996:17) first the resource throughput needs to be reduced and then through the market mechanism the pattern will change automatically. Martinez-Alier (1987:240) indicates that it is not the resource base which is infinite; rather, it is consumer demand. Thus this can be interpreted as a hint to focus on sufficiency.

Alcott (2008:771ff.) points out that the sufficiency idea means to reduce consumption of wealthy people, rather than of all people. Hence one decides between needs and wants, from which it follows that poor people still have the right to satisfy their needs, and developing countries still have the right to increase their throughput (preferably using green technology) in order to push their development[40] (Friends of the Earth 2009:6). This differentiation indicates Daly's (1996) idea of a steady state economy (Alcott 2008:772, Lintott, 1998: 240). Some may oppose a steady state economy, since it is often connected with stagnation. However, Daly never thought about cessation when he introduced the idea of a steady state economy. He clearly differentiates between growth and development, pointing out that the two are often used synonymously, although they are not (see also Costanza et al. 2013:128). Without reflection word creations like sustainable growth are used, which is according to Daly (1996:167) an oxymoron. Having in mind that nothing can grow infinitely something like sustainable growth is simply impossible.[41] Sustainable development, in contrast, is possible. Things are changing all the time and advancements that can be sustained and help in sustaining the environment are anything else but cessation. Indeed, development also needs a resource base. But in contrast to growth, which needs quantity, development needs quality (Daly 1996:167). Accordingly, it is an implicit prerequisite of development to promote the enhancement of environmental quality.

Such a shift from quantity to quality will be necessary if we first take into consideration the limits of

40 The Friends of the Earth report (2009) nicely illustrates the differences in resource extraction and consumption per day for world regions. Not only can one deduce who bears the burdens of environmentally harmful extractive activities and who absorbs the benefits, one can also realize the global differences, which are enormous.

41 Note that orthodox economy indeed uses the term sustainable growth, relying on the definition of the Brunthland report.

the planetary resource base and the negative effects of resource (over-) exploitation. In this respect it is necessary that developed countries switch to a steady state economy and to encourage developing countries not to follow the same resource intensive development path (Behrens et al. 2007:450).

> Rather than devising yet another system laying out rules that determine how countries will compete for scarce resources, we should focus on reducing the use of those resources and allowing people to access them much more equitably. Reducing resource use, primarily in the North and within the overall context of sustainable economies, is more likely to bring peace and security than neoliberal economic globalisation (Friends of the Earth International 2001:11)

Sufficiency is related to a voluntary abdication of consumption that is driven by some kind of ethical attitude. This ethical attitude and the consequent behavior are guided by the knowledge that there is some kind of limit, from which it follows that one's behavior affects others. Either we realize that overconsumption of one person leads to the impoverishment of others, or we realize that overconsumption results in the destruction of the environment, which leads to the impoverishment of all people. Hence it boils down to a feeling of responsibility for each other and the environment to economize our limited resources in a just manner. This does not only entail intra- but also intergenerational equity (Alcott 2008:771ff.). Still another reason for sufficiency can be found, which is not based on the outside world. It is simply related to people's ability to feel saturation and to the ability to gain happiness not only through consumption (Alcott 2008:779, Lintott 1998: 242ff.). As Daniels (2010:957) points out. “Ignorance of the true nature of well-being persists despite repeated empirical experience that grasping for external happiness sources does not work in terms of sustained satisfaction.” Daniels, combining the Buddhist belief with economics, goes on, stating, “The prevailing belief within consumer market societies is that the primary directives of live activities should be directed towards pleasure and usefulness (and hence welfare gains) obtained from the accumulation and control of stable phenomena of external world” (Daniels 2010:957). He indicates that that needs that go beyond basic human needs are constructed desires and that “[c]onsumption becomes an end in itself” (Daniels 2010:957).

Apart from altruism, empathy or frugality, Behrens et al. (2007:450) state that it is also in our own self-interest to decrease consumption, since consumption sooner or later influences our own wellbeing negatively through the negative impacts of resource exploitation.

Alcott (2008) discusses the problem of the sufficiency rebound effect, which means that forgone consumption leads to decreasing prices and thus the commodities might still be bought by other consumers. So basically a shift from one social stratum to another happens and consequently the impact (“I”) does not reduce much, not at all or probably even increases. The reason for this phenomenon is very nicely expressed by Lincott (1998: 245f.): “Thus, in practice, the pursuit of

growth has entailed doing more (in terms of consumption) with more (in terms of resources).” The same problem can be found for the technology variable, which will be discussed later. The reason for the rebound effect is not only found in the market mechanism but also in the attitude and goals that people have. Is consuming an end in itself or is it to increase welfare (Lintott 1998: 246)? Directing the necessity of consumption by the notion of happiness, sustainability or mere GDP growth consumption gets a different base for legitimation. Hence one can say that it depends on the wealth of consumers whether consumption is socially and or environmentally “legitimate”[42] or not. This indicates the problem of voluntary action. People with a different ethical attitude will simply act differently, using their chance to presumably increase their utility. Thus one thing is individual change of behavior, attitude and morals; the other is governmental regulation (Alcott 2008:781). If new consumers legitimately consume more and impact is accordingly not decreasing, we still can try to lower the impact by turning the other two screws: population number and technology.

7.2.3. Technology

For *Ecological Economics* technology does not have the same significance as for *Environmental Economics*. Rees (2001:3) puts the *Environmental Economics'* point of view in a nutshell: “In contemporary mythology, the cornucopia of human ingenuity has clearly displaced nature as the great provider.” He points to the belief in infinite substitution of resources, that with human brilliance a new, better technology can be developed to substitute one resource for another or use infinite resources like wind effectively and efficiently.

In contrast, for *Ecological Economics* technology is not THE solution. Not every technology invented is also helpful in reducing the resource throughput (Daly 1996:17, Biswanger 2001). Also Munda (1997:227) points out, referring to Nicholas Georgescu-Roegen, that certain technologies that saved us from one energy shortage are not necessarily a real qualitative improvement. So was the wood shortage the reason for developing more efficient steam engines (coevolutionary process). Through this the energy crisis was solved, but a new one, even if we only realize it in the last decades, evolved. The general problem that we need energy is not solved through new energy consuming technologies. Munda (1997:227) states that, according to Nicholas Georgescu-Roegen, “[...] a technology is viable if and only if it can maintain the corresponding material structure which supports its resource and sink functions, and consequently the human species.”

Daly points out that indeed new knowledge could help us to discover new low entropy sources and

42 For more information on what to define as sufficient, see Alcott (2008) and the literature he presents on that issue (2008:780). See Dittrich et al. (2012:13) for a table presenting country data on affluence.

how this energy can be used. But Daly also states that we should not be too optimistic, or at least should not only always see the bright side of new knowledge, since it could also unravel new limits to growth (Daly 1996:66f.). One example is land management, where increased application of synthetic fertilizers and pesticides had and has adverse effects on soil quality, resulting in diminishing yields (Ananda / Herath 2003:346).

Rees (2001:6f.), in referring to Kaufman, states that substituting natural capital through manmade capital does not pay off. To illustrate this he refers to one of his PhD students' research, investigating the cost-benefit efficiency of salmon farming. The finding is that compared to the natural "free" salmon reproduction, the commercial farming is much more inefficient. The same finding was also already stated by Martinez-Alier (1987), who concluded from the findings of natural scientists who dedicated their work to energetic input-output calculations (e.g., Geddes) that the replacement of human muscle power through fossil fuel driven engines did not increase efficiency. However, the change came about because the use of non-renewable energy was cheaper than human labor (Martinez-Alier 1986:188). Martinez-Alier (1987:151) refers to the belief that food shortages can be overcome through technological improvements, like fertilizers, management practices or genetic engineering. Anyway, he points out that productivity has to be analyzed from an energy input output angle and that this is again based on the availability of low entropy energy, other scarce resources and the demand. So generally one cannot blindly trust in human ingenuity to solve the problem through new sophisticated technologies.

There are two things which Rees (2001:3) indicates concerning substitution of nature though technology. First, as already indicated, it seems often to be the case that substitution of natural services or goods through manmade devices is not as efficient as the natural service. Second, it is moreover stupid to substitute a free natural product with costly, less efficient manmade products. All the additional energy needed to produce this manmade product could be directly used to feed humans. So in the end he shows with his explanation that the system is getting more and more sophisticated but also inefficient, increasing entropy.

Another issue that we encountered already above is the rebound effect, which is related to the market mechanism. The rebound effect, also known as *Jevons' Paradox,* means that due to efficiency gains the price of a product or the cost associated with the usage of the product lowers, and consumers use their released purchasing power to consume more. Accordingly, resource use does not diminish proportionally with efficiency gains (Alcott 2008:773f., Friends of the Earth 2009:24, Berkhout et al. 2000, Biswanger 2001, Haberl et al. 2011:9, UNEP 2011:359).

Rising world population and rising living standard lead to ever-increasing demand. And even if it was possible to increase resource use efficiency, demand for natural resources increases (Friends of the Earth 2009, Krausman et al. 2009). The fact that one needs less input to produce the same output is called decoupling (sometimes also dematerilaization). Absolute decoupling means that the overall resource use decreases due to efficiency gains. Relative decoupling, in contrast, means that the absolute resource use increases, while it increases at a slower pace (see Figure 33, Friends of the Earth 2009:23, Behrens et al. 2007:445).

The *Friends of the Earth* report (2009:23, see also Behrens et al. 2007:448, Krausman et al. 2009) points out that world economy today is 30% less resource use intensive than 30 years ago. However, current data does not indicate that absolute decoupling is possible (Friends of the Earth 2009:23, Haberl et al. 2011:8f., Krausman et al. 2009). And as Lincott (1998:246) puts it, “Attempting to 'delink' output from resource use […] is much less promising than attempting to delink welfare from output.” Similarly, a EUROSTAT study from 2002 using domestic material consumption (DMC) and the IPAT identity attempted to analyze whether environmental pressure de- or increased from 1980 to 2000. They conclude that although efficiency gains are achieved, this increase is outpaced by population growth and affluence (EUROSTAT 2002:45).

Other problems concern the market not providing the right incentives to spur technological improvements. Moreover, through the complexity of the ecosystem it is difficult to adapt to emerging problems through immediate technological inventions. Most importantly, even the most sophisticated technology needs a resource basis, some kind of energy and matter. Due to the second law of thermodynamics this means that technology will not halt resource consumption and thus entropy. For these reasons *Ecological Economics* does not rely on technological progress to solve environmental problems. Rather, some representatives of *Ecological Economics* even indicate that technological progress leads to higher resource throughput. Although environmental economists do believe in the potential of technology, they are aware of hurdles that prevent innovations and their application (e.g., lobbying). Therefore, right institutional settings are needed in order to unfold technology's power (Venkatachalam 2007:555).

Hardin (1968:1243) points out, referring to the population problem and the never-ending optimism concerning technological innovations, that technology will not solve the problem of an ever-increasing population. “A finite world can only support a finite population; therefore, population growth must eventually be zero” (Hardin 1968:1243). Even if we managed and still manage to increase agricultural production and nourish more and more people, somewhere are limits which no technology will ever break. As long as people need to eat and drink, technology will not

overcome humans' direct dependency on the environment. Humans need a certain amount of calories per day; if nature is not able to provide this, technology will not be able to, either (Hardin 1968). No technology on earth is able to produce matter or energy out of nothing. Natural resources limit everything, a fact that technology will not change.

7.2.4. Carrying capacity

The carrying capacity of the planet is a fundamental concept for *Ecological Economics* and it is acknowledged that humans should care about saving operating space in order to prevent collapse (Rockström et al. 2009). As explained, Malthus laid the foundation for the idea of carrying capacity[43] (Seidl / Tisdell 1999:396, Kaack, Katul 2013). Martinez-Alier[44] (1987:103ff.) states that the first one writing about carrying capacity was Leopold Pfaundler (1839-1920), who lived only one century after Malthus. Both Malthus and Pfaundler realized that a certain amount of people can be sustained by a certain territory. The supportive capacity of a territory, if exploited with highest possible (energy and matter) efficiency, cannot be amended further. Within a given territory, then, the available resources can only be increased through trade, which also costs certain amounts of provisioning capacity, since resources for trade are necessary (Martinez-Alier 1987:103ff., Seidl / Tisdell 1999:396f.). From the second half of the 20th century onward, the idea of carrying capacity was discovered again, for example, through Herman E. Daly (Seidl / Tisdell 1999:496ff., Daly 1996:50).

Arrow et al. (1995:520f.) describe carrying capacity as neither fixed or static, nor as simply related to nature. It is conditioned by technology, preferences, and the structure of production and consumption, as well as by the interaction between the physical and the biotic environment. Hence this indicates the relation to the IPAT identify. However, since the carrying capacity is according to this understanding dependent from different factors, it is difficult to identify a single number or threshold for the limit of the carrying capacity. Anyway, Arrow et al. (1995:521) state that a number defining the optimal scale of human economy is still useful.

According to Daly (1996) scale is inherently connected to the carrying capacity, which is why he is wondering about the maximum size of the economy in relation to the natural system. One can distinguish between the maximum scale and the optimal scale. There are two concepts according to which one can orient optimal and maximal scale:

43 Seidl / Tisdell (1999:402f.) explain different understandings of carrying capacity and their application. They for example also indicate the connection between the concept of carrying capacity and the IPAT identity.

44 A reason Martinez-Alier did not put Malthus as the first one who wrote about carrying capacity could be that he did not perceive him as a representative of *Ecological Economics* and rather emphasized his role in social Darwinism.

- Anthropocentric optimum: the optimum is defined by marginal utility, which is when marginal cost equals marginal benefit. According to this everything non-human is only valued in "use" terms. (→ no intrinsic value)
- Biocentric optimum: intrinsic value and ecosystem resilience are recognized. This scale would be smaller than the anthropocentric one (Daly 1996:51f.).

Seidl and Tisdell (1999:403) point out that it was Hardin (1986:1244) who realized that the concept of carrying capacity can be applied to human population. "The application of carrying capacity to the human species requires the recognition that the carrying capacity is foremost socially determined, rather than biologically fixed due to the important influence of human consumption patterns, technologies, infrastructure, and impacts on the environment or food availability" (Seidl / Tisdell 1999:403). Thus Seidl and Tisdell (1999:403) indicate that there is not only a biophysical carrying capacity determined by supply and human needs, but also a social carrying capacity given by the social system.

Carrying capacity can be seen in context with scale and with the 2nd thermodynamic law. The transformation of low entropy to high entropy energy should not exceed the inflow of low entropy energy and the capacity of nature to assimilate the high entropy energy waste, which is in direct relation with the scale of the economy (Daly 1996:66). The next section will further expand on thermodynamics and its meaning for *Ecological Economics*.

8. Thermodynamics as one basic scientific concept shaping Ecological Economics

Thermodynamics has influenced ecology since 1925 through Alfred J. Lotka; however, energy flow and questions concerning energy efficiency had an earlier influence, but not through its own body of research (Martinez-Alier 1987:45). Major contributions in connecting thermodynamics with economics can be attributed to Frederick Soddy and Nicholas Georgescu-Roegen (Daly 1996:172ff., Munda 1997:226, Asafu-Adjaye 2005:24). Thermodynamics entails major principles for *Ecological Economics.* It is not so much the first law of thermodynamics (conservation of energy) but rather the second law of thermodynamics that has major implications for energy availability. In the second half of the 19th century Rudolf Clausius formulated the second law and introduced the term entropy in relation to heat. According to his theory heat is always characterized by energy and entropy, and entropy is irreversible in a closed system (Martinez-Alier 1987:78). "[A]ny use of heat to produce work is accompanied by an irrecoverable loss of energy, to be seen as an increase in entropy" (Martinez-Alier 1987:78f.). The economist Nicholas Georgescue-Roegen wanted to apply thermodynamics to economics in order to quantify the throughput

necessary for economic activity and thus illustrate the produced entropy (Martinez-Alier 1987:79, Daly 1996:185).

Based on *Environmental Economics'* preanalytic vision, it is clear that the discipline considers the relation between environment and economy. One must conclude that for sustaining a certain magnitude of the economy, one needs a certain amount of resources that come from the natural environment, and ultimately from solar energy.[45] Therefore not only the scale matters, but also the biophysical parameters and rules followed. Since energy (together with matter) is requisite to sustain human life, society and hence the economy, *Ecological Economics* deals with the fundamental laws that explain how energy behaves. From these laws basic conclusions are drawn regarding the economy and its basis.

Thermodynamics deals with energy and how energy behaves. Energy is the basic component to transform matter or energy. In this transformation energy obeys two thermodynamic laws. The first one is the Law of Conversation of Energy; the second is the Entropy Law.

1st thermodynamic law: According to this law, energy cannot be produced or consumed. In an isolated system there is a constant level of energy that can be transformed in other forms of energy (e.g., heat to motion) (Asafu-Adjaye 2005:19).

2nd thermodynamic law: In transforming the energy the quality of the energy changes, from low entropy to high entropy energy. In a very shortened way, entropy can be defined as the potential of energy to perform a task. The transformation of energy is never 100 percent efficient, since some energy is always needed for the transformation itself. Through transformation (usage), low energy entropy becomes high entropy energy, thus this energy becomes waste, since we can only use low entropy energy for transformation. Considering the economic system, the energy taken from the ecosystem (source) has low entropy; by transforming it for human purposes, it becomes high entropy waste that is re-channeled to the ecosystem (sink). Within this process the total amount of energy stays the same; only the quality changes (Daly 1996:58, Asafu-Adjaye 2005:20, Martinez-Alier 1987). Daly (1996:58) argues moreover that merely shifting energy from one point within the

45 Martinez-Alier (1987:74) refers to nuclear energy, which is not dependent on the sun, but like other non-renewable energy sources, it is dependent on a stock of radioactive material. Additionally, we are also already talking about peak Uranium (IAEA 2001), and the use of radioactive material brings about many other problems. Moreover, Hardin (1968:1244) points out if we assume an infinite source of energy – which nuclear energy is not – the problem of dissipation remains. Apart from the whole use for mass destruction, political power games and contamination of the planet for tests, energy production through nuclear fusion also has its negative sides. The often ignored issues of ultimate disposal and the question of safety (see Tschernobyl, Fukoshima) are not solved (see Greenpeace, David Suzuki Foundation). Other sources like wind or waterfalls are related to the influence of the sun. What remains is geothermal heat and tides.

system to another influences the system, since it becomes unavailable at one place and available at another one. Moreover, the shifting process has certain transaction costs, since one cannot transport energy without using energy.

If the ecosystem was an isolated system, earlier or later only high entropy energy would remain, hence there would be no energy available to be used. Luckily the ecosystem is a closed one, which means that energy is exchanged with the superior system, the solar system and the universe. Ultimately it is the solar energy that provides us with usable energy. Figure 7 below shows how the energy flow can be understood.

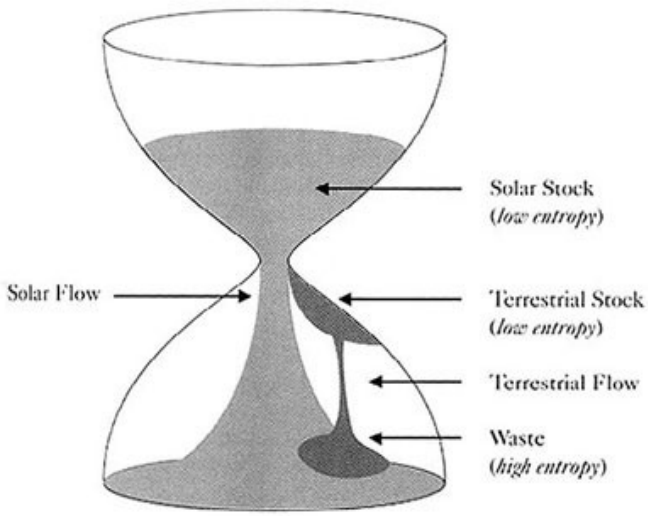


Figure 7: Thermodynamics and the available energy stock (Daly 1996:29 after Georgescu-Roegen)

Within this figure it is assumed that no energy enters the system; however, the sun is part of the system (solar stock). Then the following applies:

1. No energy enters the hourglass, no energy leaves it → first law of thermodynamics → energy cannot be consumed; it can only be used and thus transformed. “Law of Conservation of Energy”
2. Energy is accumulated at the bottom, which is the used energy that has a high entropy, so it is waste. “Entropy law”
3. There is another “source” of energy illustrated, which is stored solar energy in the form of fossil energy carriers. As soon as it is used it follows the 2nd thermodynamic law. In contrast to the solar source the fossil source is a very limited stock.
    - Solar source: abundant stock, but restricted flow
    - fossil source: restricted source, but abundant flow (Daly 1996:29f.)

“[S]olar low entropy […] is nearly infinite in total amount but strictly limited in its rate of flow to

earth, whereas terrestrial low entropy (concentrated in minerals in the earth's crust) is strictly limited in total amount, but can be used up at rate of our own choosing" (Daly 1996:185).

Podolynskyj already realized the difference in using the flow of solar energy and the stock of coal (Martinez-Alier 1987:52). For Podolynskyj human labor should be used to increase accumulation of solar energy, rather than exploiting the stock of solar energy captured in fossil fuel deposits (Martinez-Alier 1987:52). Martinez-Alier (1987:73ff.) is referring to another scientist, Rudolf Claudius, who lived at the end of the 19th century. Clausius wrote about the necessity to shift resource use from non-renewables to renewables, which is due to its exhaustibility, its finiteness and that it is uneconomic to consume within a certain time span more than is reproduced within the same time span (Martinez-Alier 1987:73). Therefore Clausius already had the vision that the task of the next generations is to install an economy that uses planetary resources wisely, meaning that non-renewables should not be exhausted since they are finite and would then no longer be available for future generations. He urges a quick change in human resource use and that the advanced nations should work together to save and manage non-renewable resources, as they should manage sustainably the use of renewables (Martinez-Alier 1987:75). Claudius wrote this in 1885, 100 years before I was born, and now 129 years later we have not substantially changed our consumption patterns. Martinez-Alier (1987:87) states that in contrast to Jevons, who suggested short term exploitation in order to promote economic progress, Clausius was in favor of taking a long term perspective. Clausius explained this perception with the definition of income, which is not using more in one period than can be reproduced within the same period. Therefore he was not only aware of a sustainable use and the very principles of economy, he also took into account that the transformation to coal takes much longer than its exhaustion.[46]

As already noted, the ultimate source of energy is the sun (Haberl et al. 2004[a]:279). The important thing about this energy source is that it is a nearly unlimited source, but that the flow and the capacity to capture this flow on earth are limited. Plants (autotrophs) transform solar energy and build a stock called Net Primary Production (NPP). From this stock the terrestrial production chain starts. However, the amount of NPP that can be built is limited to the available territory, its characteristics (soil, climate, etc.) and the efficiency of energy transformation within plants and following transformation entities. The conclusion from this is that the economy and our lives are dependent on this solar inflow and the terrestrial conditions that allow plants to grow. All these factors are limiting factors that cannot be influenced in a way that would render possible infinite growth (Haberl et al. 2004[a]:279).

46 Compare Barnett's analysis of the first conversation movement at the end of the 19th century; see footnote No. 37.

The positive thing is that as long as the sun shines, plants exist and the conditions for plant growth are fulfilled,[47] low entropy energy for all kinds of purposes is available. How much of this energy is available depends on the flow of solar radiation and the capacity of plants to store it. The amount of radiation flowing to earth cannot be influenced by humans; the capacity and the conditions for its storage, in contrast, can be influenced by humankind through colonization and management practices. However, Daly correctly points out that "[...] most of the matter/energy transformations of the ecosystem are not subject to human control either by prices or by central planning" (Daly 1996:58). Of course, NPP technologies that capture renewable energy, like solar energy, wind energy or water energy, allow us to increase energy availability, while for construction and maintenance matter and energy is needed as well. Therefore, for such technologies the energy and matter input-output efficiency needs to be tested.

Since the provisioning function of NPP for the rest of the production chain is usually not reflected in neoliberal thinking and not covered by its mechanisms, humans' influence on the ecosystem is external to these mechanisms (see Barnett 1960:447). In case of negative externalities, the functions of the ecosystem are diminished, which in turn influences the economy, expressed in resource shortage (scarcity). The *Ecological Economics'* preanalytic vision leads to another major difference in the understanding and functioning of the system. Remember that the neoliberal system is an isolated, circular one, where processes are reversible. This does not apply for the vision of *Ecological Economics*. Due to the second thermodynamic law, transformation of energy is irreversible. "But the inclusion of physical dimensions in the circular flow [model of neoliberal economy] is flatly ruled out by the second law of thermodynamics, the entropy law, which says that the quality of matter / energy that gives rise to usefulness is used up and is not recyclable" (Daly 1996:195). If the energy has been transformed once, this is not reversible anymore. "[I]n contrast to the reversibility of mechanical phenomena, entropic phenomena are characterized by irreversibility, a fatal weakness of the mechanistic epistemology of standard economics [...]" (Daly 1996:185).

From all this the conclusion is obvious: Energy and matter not only have a perceived relative scarcity component, they more importantly have an absolute scarcity feature. "This qualitative degradation of the matter/energy throughput, along with the purely quantitative dislocation of the

47 Through this the threat of climate change becomes apparent. Not only that the source of fossil energy carriers is finite, which – in the in the fossil fuel dependent world we live now – threatens human lives. Also the combustion of this energy carrier influences the environment such that environmental conditions change and may pose a threat to human lives as well. Additionally the adaptive capacity and resilience of the environment is weakened by human economic activity which makes it and consequently humans more vulnerable to perturbations.

same, induces changes in the ecosystem which to us are surprising and novel because our information and control system (prices) assumes nonscarcity (nondisruptability) of environmental sources and sink functions" (Daly 1996:58f.). The exhaustibility of natural resources is hence not reflected in the present economic system. Moreover, the neoliberal economic system, based on the assumption of infinite natural resources, strives for infinite growth. As long as economic growth is not in absolute terms decoupled from resource use, the goal of infinite growth is simply not possible. "Therefore, in the long run, economic growth will be limited by solar energy and our ability to convert it to work" (Asafu-Adjaye 2005:21). This obvious mismatch between reality and theory can only be recognized if analysts take the natural environment into account and measure it with biophysical indicators.

Understanding the economy as a subsystem of the ecosystem, which is a subsystem of the universe, leads to the conclusion that the economic system should acknowledge the same biophysical laws that are also followed by its superior systems (Asafu-Adjaye 2005:22). The first thermodynamic law, as already explained, means that in an isolated system the aggregate amount of energy remains stable. The second thermodynamic law says that used energy is transformed into high entropy energy. From this follows that the more we take out of the environment in the form of low entropy energy, the more high entropy energy has to be dumped back into the environment. "Throughput starts with depletion and ends with pollution" (Daly 1996:31). We reach the limits of biophysical capacities on both ends of the chain, at the source and the sink side. Recycling is no solution to this, since it will require low entropy energy as well and produces high energy entropy (Asafu-Adjaye 2005:31). Moreover, the transformation of energy is never 100 percent efficient, thus inevitably energy will be lost within this process (Martinez-Alier 1987:50). Therefore matter can be recycled to a certain extent, but this also involves the transformation of scarce energy, which cannot be recycled (Daly 1996:195).

Given the limits of sources and sinks, unlimited growth is a myth. This is why Herman Daly (1996) suggests de-growth (for mature economies) to achieve the "steady state economy" (see also Asafu-Adjaye 2005:222ff.). The unsustainable pattern is not merely due to the transformation and usage of matter and energy; it is that the rate of usage is higher than the rate of reproduction. Thus existing stocks (like fossil fuels or soils) are depleted. We are not living from the income, but the savings, which is why more and more resources are perceived as being scarce. Asafu-Adjaye (2005:24) indicates that it is innate to the current economic system that resources are used at such unsustainable rate that they will become ever scarcer. As long as the current economic system does not entirely include – or more correctly, as long as it is not included in – the ecosystem, externalities will persist. Internalization will go on until everything is internalized. As Pearce

(2002:61) points out, since externalities seem to be inherent to economic actions, the market system can be very inefficient. Daly (1996:11) criticized that instead of introducing a model that better fits the real circumstances, the old flawed model is adapted infinitely. It is questionable whether the current economic methods are able to unravel the unsustainable usage of resources, since they only use the monetary indicator for evaluation. Monetary input-output calculations, so far, are not able to fully capture inputs and outputs. This would be easier using the particular biophysical[48] unit and indicator.

Daly (1996:197) points out that not everything has to change with the integration of thermodynamics. Some topics would remain: "Supply and demand, elasticity, marginal costs and marginal revenue, how banks create money, monopoly, pure competition, etc." (Daly 1996:197). Price theory will have to undergo certain changes, since prices do not reflect absolute scarcity (ibid.).

Daly comes up with eight specific suggestions and one overarching suggestion as to what would have to be changed in order to reflect thermodynamics in orthodox economy. The overarching suggestion is to change the preanalytic vision to reflect the nature-economy relation and the laws the environment obeys (Daly 1996:193f.). "[T]he concept of the entropic throughput is a Trojan horse. Once it is admitted within the hardback covers, its hidden army of implications attacks nearly every section of the book" (Daly 1996:194). The specific suggestions are:

a) mechanistic system: this is quality-less and reversible, which diametrically opposes the entropic law, which describes a process that is an irreversible change in the quality of available energy (Daly 1996:194).
b) continuous economic growth: it would become impossible and even undesirable, since the negative effects of perpetual real GDP growth would undermine future real GDP growth in the long run (Daly 1996:195).
c) accounting: emphasizes the throughput of an economy, illustrating the capital balance (Daly 1996:196f.).
d) technological innovation: is not THE solution to resource scarcity, although it can improve efficiency. So technologies must not increase aggregate throughput, but keep it stable or minimize it in real terms, while increasing the efficiency (Daly 1996:195).
e) distribution: both inter- as well as intragenerational justice needs to be considered. The first is in line with the sustainability concept, guaranteeing the present generation a decent life without impoverishing future generations. The latter refers to the redistribution of wealth within the present generation. This cannot be achieved through

48 And concerning social issues, the proper quantitative and qualitative indicators would have to be used.

infinite growth (Daly 1996:196).

f) development: the concept needs reconfiguration, away from impossible goals – that exceed biophysical limits – to possible ones. New emphasis on redistribution, population control, limited inequality and sufficiency (Daly 1996:196).
g) production function: substitution of production function reflected in a realistic way, thus acknowledging that labor, capital, and resources are complements and not substitutes and that labor and capital are agents to transform the resource (Daly 1996:197).
h) Population number: population control is needed in order to keep the resource throughput at least stable and decrease it in the long run (Daly 1996:197).

8.1. Thermodynamics and socioeconomic implications

The second law of thermodynamics determines irreversibility of energy conversion; hence energy availability will come to an end. In an isolated system where there is no new low entropy energy added, entropy inevitably increases. In a closed system, the kind of system that we live in, luckily new low entropy energy enters that allows us to live and operate all kinds of actions. Nonetheless entropy inevitably increases, and we are dependent on the amount of energy inflow that sun provides and that can be captured through NPP. Probably it was this dire prospect and the retrospect on dire agrarian times (Martinez-Alier 1987:81, see also Martinez-Alier 1987:118f.) that led to an act of defiance, neglecting the limits and going on celebrating human ingenuity that ostensibly released us from natural limits (see for example Barnett 1960:438), hoping that the limits we once broke through will allow us another time to overcome the limits. This is why we still believe in technological progress as salvation from natural boundaries.

> In recent years, some economists have expressed caution about interpretation of the Second Law of Thermodynamics. The point has been made that although non-renewable resources are finite in supply, they are not *the* constraint for the survival of humanity and the ecosystem. Many believe that technology progress could facilitate a shift from reliance on non-renewable to renewable energy. This would happen once we reach the point where the costs of extracting and refining natural resources exceed the cost of recycling. (Asafu-Adjaye 2005:25)

The technology factor was already discussed; the important thing I want to point out here is that Industrial Revolution was a turning point. The inventions of that time that allowed the use of a huge resource reservoir, fossil fuels, that allowed increased production and changed society. During this time the strong belief in human ingenuity, perceived to be superior to all natural chains, was born and is vital until today.

“That the 'Industrial Revolution' implied going beyond the limits of the 'circuit of life' and that it allows humankind to break out of the agrarian cycle of abundance and hunger, impressed many students of social and economic history” (Martinez-Alier 1987:79). “Economic development since

the Industrial Revolution has been in the direction of ever less reliance on the abundant solar flow and towards this dependence on the relatively scarce terrestrial stock" (Daly 1996:185). These two quotes illustrate the importance of the Industrial Revolution. Not only did human resource demand increase like never before, also the source of energy for the first time changed from renewable to non-renewable resources. Moreover, increasing the output where it was believed that output cannot be increased and will be the limiting factor to human wealth, induced humans to believe that they are victorious over natural forces. No longer are humans slaves of unpredictable nature;[49] their infinite ingenuity seems to make them the dominators of nature (Barnett 1960:438).

The use of coal for the economic progress was extremely important and the availability of and access to coal was thus a decisive condition to allow this progress, to keep pace with other nations and to probably outpace and leave others behind (Martinez-Alier 1987:86f.). Martinez-Alier (1987:87) refers to Jevons, who wrote about the "Coal question", but not in the sense of using the coal reserves slowly in order to allow long term usage; rather, in relation to allow and consolidate economic power. This reveals that resource availability and access are deeply connected to the struggle for power. Access to all kinds of resources was the motor for expeditions, in order to find direct trading routes and new resources. It was the motor for slave trade and the genocide of the indigenous people. Resources for production, labor and natural resources were the basis for economic progress. As labor can be replaced through non-renewable resources and boost the economy like never before, how can one demand a nation to stop the extraction and use of exhaustible resources in order to leave more for next generations, when it is important to keep pace now?

Soddy made a differentiation, similar to Lotka, that of endosomatic and exosomatic energy. Martinez-Alier (1987:135) states that this differentiation makes economics necessary. The first is the use of energy to sustain the body functions; the latter is the use of energy to perform labor (Martinez-Alier 1987:135f.). The first stays more or less the same, while the latter differs from person to person and from era to era (socioeconomic transition) (Martinez-Alier 1987:136). For human survival plants will always be needed; for labor in contrast other means of energy can be used. However, since endosomatic energy ingestion is the precondition for exosomatic labor performance, NPP is the real limiting factor to wealth (Martinez-Alier 1987:136). "[U]se of coal (or oil) meant using capital instead of revenue, and coal (or oil) could only be used indirectly for life" (Martinez-Alier 1987:136).

49 For information about the role of the Green Revolution see Evenson and Gollin (2003) or Pingali (2012).

9. The meaning of 'growth' within the framework of sustainability

Environmental Economics does not reject the growth paradigm. Economic growth and sustainability are not perceived as contradicting concepts. As Wissen (2012) pointed out, the sustainability concept never opposed the growth paradigm;[50] it was rather supported as the only means to eradicate poverty (see UN 1992: Principle 12). Thus the definition of sustainability is interpreted in a way agreeing with the underlying assumptions of neoliberal economic theory. Not only articles dealing with *Environmental Economics*, but also the UNEP GER interpret sustainability in this way. The definition of sustainability is taken from the *World Commission on Environment and Development's* (WCED) report *Our Common Future* (WCED 1987: Chapter 2.§1):

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> - the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
> - the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Interpreting this definition from a neoliberal point of view, one can say that it means a sustained increase in human wealth, which is determined through the idea of utility and consumption over time. The wealth of present generations should not compromise the wealth of future generations. Thus future generations should at least have the same opportunities as the present one (Pearce 2002:62, UNEP 2011:17, Borgström Hansson 2003:84). Thus, in an economic sense, sustainable development means that economic growth can be pursued now and in the future, providing present and future generations at least with the same resource endowments. The UNEP GER (UNEP 2011:17) points out that the opportunities given are not only dependent on man-made capital stock[51] but also on the natural capital stock. Both stocks are needed for sustainable development.[52] Natural capital is necessary to build up human capital, financial capital, etc. At the same time human capital is needed in order to allow further human development. It is acknowledged that to keep within sustainable limits a balance between usage and formation of different capital stocks

50 At least not the weak sustainability concept. Strong sustainability does not promote the complete substitutability of social, ecological and economic factors and thus not the substitutability of natural and man-made capital.

51 "[...] capital is decomposed into human-made capital, human capital (knowledge, skills), natural or environmental capital, and social capital." (Pearce 2002:62)
Also Cotanza et al. (20111) distinguish 4 different types of capital: natural, built or manufactured human and social capital. Costanza points out that only natural capital does not need human inputs to be built and maintained.

52 El Serafy (1997:219) points out the complexity of understandings concerning the sustainability concept. The difference between strong and weak sustainability leave often a lot of space for interpretation. Sustainability can also be attached to different kinds of capitals. Thus we can have sustainable human capital, sustainable natural capital or sustainable financial capital.
Costanza et al. (2011) point out that a combination of all stocks is needed to produce human benefits.

has to be found. This means, however, that if, for example, natural capital stock is abundant it has to be sacrificed to build up other forms of capital stocks that are underrepresented (UNEP 2011:17). Sustainability is reached as long as the total stock keeps stable or increases per capita over time (Pearce 2002:62).

Making trade-offs between the different capital stocks is called weak sustainability. Although no one claims that natural capital stocks can be drawn down completely, the different capital stocks are perceived as being substitutes to a large extent, rather than complements. This is illustrated through production functions like the Cobb-Douglas production function discussed above.

It has been shown that rising GDP is correlated with rising matter and energy consumption (Dittrich et al. 2012:33, [Figure 33 in this thesis], Krausman et al. 2009, Behrens et al. 2007), hence one might question whether economic growth does biophysically allow sustainability. Neoliberal economics and *Environmental Economics* believe in technological innovation, which will ultimately allow decoupling economic growth from resource use. Accordingly, economic growth does not oppose sustainability. The role of technological innovation was discussed previously, examining the IPAT identity, and it was already pointed out that relative decoupling is achievable. The future will reveal whether absolute decoupling will also be possible.

Economic growth is seen as the panacea to social and environmental problems (UN 1992: Principle 12, UN 2012, Daly 1996:5f., Rees 2001:1). The theory explaining the ostensible positive effect of economic growth on the environment is the *Environmental Kuznets' Curve* (EKC), which is the theory of the *Kuznets' Curve* applied to environmental problems. The next subsection will expand on this theory.

9.1. Environmental Kuznets' Curve as fundamental theory for Environmental Economics

The *Environmental Kuznets' Curve* (EKC) can be seen as the first decoupling hypothesis. Thus decoupling is nothing new, but rather an old idea in new clothes. However, decoupling will be discussed later (EUROSTAT 2002:37).

Selden and Song (1994) were the first to adapt the *Kuznets' Curve* (KC) to environmental problems. This application of the KC is called the *Environmental Kuznets' Curve* (EKC). The theory of the KC states that development has an inverted U shape; hence, increasing income leads initially to increasing environmental degradation, and at a certain point the relationship reverses. Economic growth is the key precondition to gain human wellbeing. Concerning environmental problems, economic growth is the cause and the cure. Thus a certain income level needs to be

reached where growth offsets its negative environmental impacts (Asafu-Adjaye 2005:266).

The EKC is the pendant to the KC[53] which describes a direct correlation between the level of national income and its distribution. The relation is shaped in an inverted U, illustrating that with rising national income, income distribution diminishes until the tipping point is reached, and distribution equality rises again (Kuznets 1955, Moran 2005:211ff.). The basis for this theory is, amongst other factors, the assumption that with rising income people care more about inequality and social unrest resulting from inequality, and thus aligning income equality is promoted (Moran 2005:213). The same is believed to be true for environmental pollution and destruction. At the beginning of industrialization, pollution and destruction increase until income reaches a certain level – the curve reaches its peak – followed by decreasing pollution and destruction (Arrow et al. 2005:520, Dasgupta et al. 2002:147). Decreasing environmental pollution can be explained through the market mechanism or more precisely through the utility function (Borgström Hansson2003:85ff.). Dasgupta et al. (2002:149) state that an EKC can be observed if incomes rise, "[...] marginal utility for consumption is falling or constant; the disutility of pollution is rising; the marginal damage of pollution is rising; and the marginal cost of abating pollution is rising."

As already indicated, the turning of the curve is related to people's situation and attitude. It is their force that leads to change in income distribution as well as environmental protection. Plassmann and Khanna (2006), for example, point out the importance of people's attitude. They conclude "[...] that it is generally not sufficient to improve abatement technology because whether pollution increases or decreases with income still depends on the consumer's willingness to pay the price of reducing pollution" (Plassmann / Khanna 2006:637). This willingness to pay is connected to the scarcity issue. As mentioned above, it is the relative perceived scarcity that makes an environmental commodity worth being included in the market system. Wiesmeth (2012:46) points out that the perception of scarcity seems to be related to human well-being, and thus with the level of GDP. He indicates that throughout the industrial age more and more credentials of scarce environmental commodities are discovered through scientists. Illustrating this, he refers to the depletion of the ozone layer that was only recognized through scientific research. So it is not only the awareness of people that matters; there is a pre-stage necessary: scientific research.

Allocating a high budget for research and development is usually not a priority in poor countries; therefore, they might not even have the chance to discover scarcity. And if it is discovered already, whether through national or international research, the next problem is that in countries with low GDP people often have other problems than nature conservation. "Developing countries are

53 For more information about the KC its rise and connection to development economics see Moran (2005).

therefore typically characterized by a low level of environmental awareness, accompanied by a variety and in many cases increasing numbers of environmental problems. Simple economic issues such as sufficient amount of food or a suitable place to live are, at least temporarily, more important" (Wiesmeth 2012:46). However, to overcome these teething troubles economic growth is needed. It will increase the budget for R&D and ease population's pressing survival problems and thus release energy that can be devoted to environmental problems (World Bank Group 2012).

Apart from people's ability to mitigate environmental degradation, it is also the economic structure which has an influence on the environment. An economy with an increasing share of the tertiary sector has a lower impact than one with a high share of the secondary sector. Moreover, it depends on what kind of industry is prevailing in a country. Manufacturing and high-tech activities are less polluting than the extraction of raw materials (Common / Stagl 2005:247f.). Therefore the aim is to transform the economic structure.

9.2. Ecological Economics counter-arguments proposing limits to growth

From the analysis undertaken so far it is clear that *Ecological Economics*' point of view is different. This will be outlined in this section.

Rees (2001:1), for example, points out that according to the neoliberal thinking, wealth is gained through continuous economic growth and the underlying consumption. "The popular culture of high-income countries persuades us that greed is good and that we can indulge our wildest materialist fantasies free of social guilt or ecological recrimination" (Rees 2001:1). From what was explained so far, it is clear that we are living on a finite planet, with finite resource stocks and a finite usable energy supply. Accordingly, infinite economic growth is impossible due to biophysical principles (at least as long absolute decoupling is not possible). From the previous explanations on the KC, the neglect of this biophysical reality is obvious. It is believed that through growth, sooner or later everyone can live a decent, comfortable life and no redistribution would be needed to arrive at a certain level of wealth. Rees (2001) even indicates that hard-liners believe that growth is not the reason for environmental degradation; rather, it is poverty. So growth is the only solution.

It has to be pointed out that limits to growth do not mean that one part of the global population will never have the opportunity to live a wealthy life, nor does it mean stagnation. It was already discussed that Daly (1996) distinguishes between growth and development and that infinite development is possible, while infinite growth is not.

As noted before, the impact of the economy depends on its structure. Accordingly, in order to

reduce environmental impact the goal is to develop the economy and increase the share of the service sector and less polluting activities within the secondary sector. However, for manufacturing and high-tech production, inputs are needed; hence they need to be extracted and processed somewhere. So far it is mainly developing countries that bear the burden of these dirty industries (see, e.g., Dittrich et al. 2012:26f.). This is why the pollution in developing countries is often high, and the domestic material extraction (DME) is higher than the domestic consumption of the materials. Seen from a global perspective, it is impossible that every nation focuses on the tertiary sector and manufacturing. Resource extraction has to take place somewhere (Common / Stagl 2005:248). Using analysis methods like the EKC and focusing only on the national level delivers a very distorted picture. Dirty economic activities are transferred to the developing world, equipping the developed world with a clean record. Not only that, national economies' true environmental impact is concealed; moreover, inhabitants of these nations believe themselves to be safe from environmental pollution, which is not the case.

Many environmental problems are transboundary, hence cause and effect are not bound to national borders. The most obvious example is climate. It does not matter where GHG are emitted, it changes the whole climate (Common / Stagl 2005:248). Common and Stagl, for example (2005:249, see also Arrow et al. 1995:520, Dasgupta et al. 2002:149), point out that especially transboundary pollution data does not exhibit an inverted U-shape. On the other hand, Arrow et al. (1995:520) argue that the U-shape is likely to hold for resource stocks where a clear feedback can be observed, like soils or forests. Another aspect is that measuring single pollutants and their diminution or increase does not tell anything about the overall reduction of pollutants. Polluting substances can be substituted by other polluters or shifted to other territories (Arrow et al. 1995:520). Asafu-Adjaye (2005:273ff.) discusses several studies and concludes that no clear relation can be found. Opschoor (1997:281) also states that the EKC does not hold for reality. A study on member countries of the European Union shows that the EKC theory holds for some countries but not for all. It is concluded that no clear pattern can be found whether there is a tipping point and if so, where this is (EUROSTAT 2001:41ff.).

Asafu-Adjaye (2005:272) points out "[...] that there is not much difficulty to constructing a model that would generate EKC-type characteristics. The challenge is to find empirical evidence that backs up the theory."

"From the current empirical evidence, it is unclear whether the EKC is the result of economic growth and therefore best tied to income increase, or whether it is merely a symptom of other underlying exogenous changes" (Asafu-Adjaye 2005:277). Therefore Asafu-Adjaye (2005:278)

argues that recent studies on that issue try to find other reasons for changing environmental pollution patterns. Relations are found in historic events, like the oil crisis in 1973, or other factors like the abatement costs, or the adverse effects of pollution on production.

Wiesmeth (2012:211ff.) expands on the climate change issue and on international agreements like the *Kyoto Protocol* and its descendants. The EU wants to implement higher climate change mitigation targets; the USA and China, in contrast, do not. However, considering the USA and the EKC hypothesis, one might think that regarding the USA's developed level they should also strive for better environmental agreements. Hence, such a behavior cannot be explained with the EKC. Economic power games inhibit stricter agreements.

Arrow et al. (2005:520) point out other weaknesses of the EKC theory. Apart from transboundary pollution, many pollutants accumulate over time, therefore their negative impact increases on a long term scale. They also indicate that only pollutions are covered so far by the hypothesis but not stocks like soil or biodiversity. Moreover, as already indicated, trade also has its stake. Many developed countries shift their polluting industry to other nations, hence “[...] reductions in one pollutant in one country may involve increases in other pollutants in the same country or transfers of pollution to other countries” (Arrow et al. 1995:520, Dasgupta et al. 2002:148f.). Dasgupta et al. (2002:159f.) also hint at the “race to the bottom” issue, which means that through globalization and the global pressure to attract companies, environmental regulations decrease or are simply not enforced. And last but not least, they emphasize that reductions in emissions may not so much be reasoned by mere economic growth, but rather by institutional reforms forcing change through legislation. The role of institutions was already highlighted by Kuznets himself (Kuznets 1955:25, Arrow et al. 1995:520). Now a vast range of literature is dedicated to the preliminary role of institutions and governmental environmental regulations (Dasgupta et al. 2002:152ff., Arrow et al. 1995:520, Asafu-Adjaye 2005:274f.).

Accordingly economic growth is not the solution to all the environmental problems we are facing today. As Arrow et al. (2005:520f.) point out, the automatic reduction of environmental pollution might hold for some pollutants but not for all. And even in the cases where such a reduction is observable, irreversible harm might already have taken place (Venkatachalam 2007:554, Asafu-Adjaye 2005:285f.). So apart from the fact that the EKC theory is very controversial, again we find that in contrast to *Environmental Economics, Ecological Economics* does not believe in a mechanistic system compound of substitutables, but rather in a complex, dynamic system comprised of a fragile interplay of complements. Such a preanalytic vision does not see economic growth as the cure for environmental problems. It is not that *Ecological Economics* is totally against

economic growth, but it does not perceive economic growth as the only facilitator of wellbeing. Economic growth is perceived in a much more balanced way, accepting its necessity up to a certain level.

Wiesmeth (2012:47) makes an interesting statement concerning the relation between economic growth and environmental degradation and protection. In line with the EKC theory, it is people's self-interest which leads to more environmental awareness. However, to gain this awareness people first need to experience the negative effects of environmental destruction. Considering the irreversibility of many processes it is doubtful whether this is a good strategy.

> While they [analysis in line with Kuznets' inverted U theory] do indicate that economic growth may be associated with improvements in some environmental indicators, they imply neither that economic growth is sufficient to induce environmental improvement in general, nor that the environmental effects of growth may be ignored, nor, indeed, that the Earth's resource base is capable of supporting indefinite economic growth. In fact, if this base were to be irreversibly degraded, economic activity itself could be at risk (Arrow et al. 1995:520).

Uncertainties and irreversibility of environmental degradation, which may have in turn huge negative effects on human beings and the consideration of the biophysical reality, results in *Ecological Economics* following the strong sustainability concept. This is one major difference between *Environmental* and *Ecological Economics*, which is also based in their respective preanalytic vision. Different kinds of capital are not seen as substitutes, but as complements of a complex socio-ecological system.

10. Proposed market-based solutions of Environmental Economics to address environmental problems

As already discussed, environmental problems are believed to be caused by missing markets. Therefore the theory of *Environmental Economics* strives to accomplish the market system (Wiesmeth 2012:44). The aim is to create incentives to internalize full costs. This idea was first stated by the English economist Arthur Pigou (1877 – 1959), who suggested introducing a tax that compensates for environmental damage (Pearce 2002: 58, Stavins 2007:1, see also Venkatachalam 2007:550).

As illustrated above, environmental commodities call for instruments that solve market failure. The most popular means is internalization, which is a strategy that is mainly an issue of microeconomics, where the focus is on prices striving to fully reflect social and environmental costs

(prices should reflect full a social marginal opportunity costs). So through this mechanism problems are thought to be solved (Daly 1996:45). According to Daly (1996:11) internalization is THE neoliberal strategy, aiming at including everything within the economy to internalize everything until everything has a price (see also Rees 2001:2f.).

10.1. Ecosystem services

Before expanding on *Environmental Economics*' proposed approaches to tackle environmental problems, I will expand on the concept of ecosystem services. So far I sometimes used the term environmental commodities and sometimes ecosystem services. The term commodity subsumes goods and services. However, for environmental or natural commodities the term ecosystem services is more common. What the term exactly means will be explained below; first I will briefly outline the history of that term.

The first step, before any internalization can happen, is to realize that environmental commodities have an effect on human wellbeing. If environmental degradation had no impact on human wellbeing it would not make sense to put a price on it. “From the ecosystem services approach the conservation of ecological systems stands out as a necessary prerequisite for long term economic sustainability” (Gómez-Baggethun / Ruiz-Pérez 2011:615).

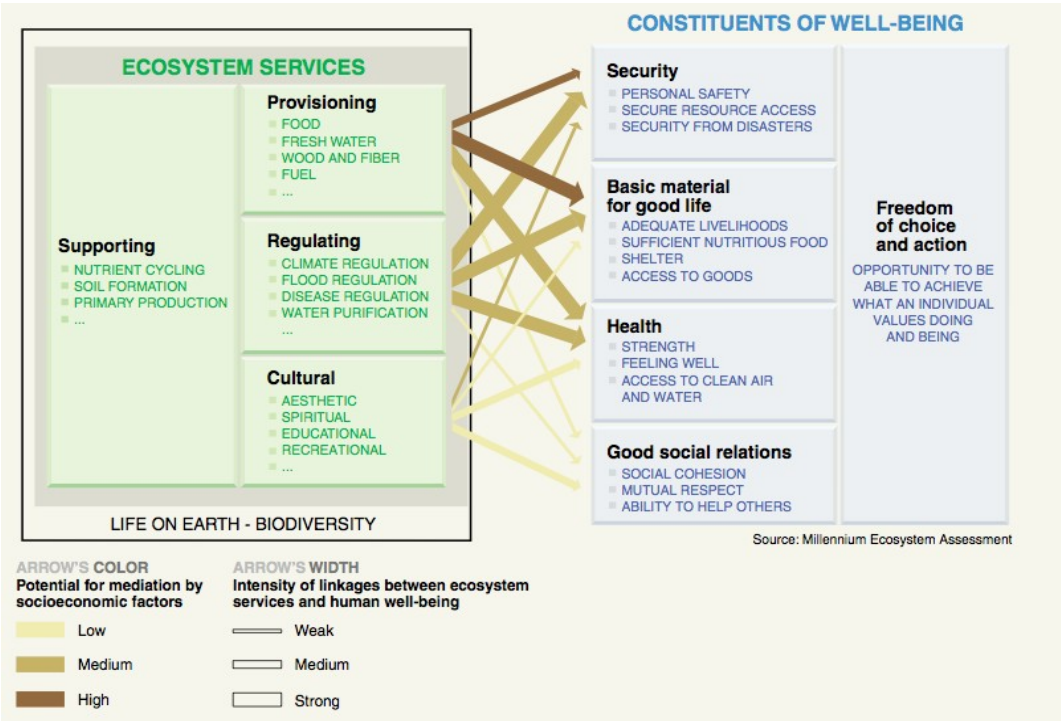


Figure 8: Linkages between ecosystem services and human wellbeing (MEA 2005: 50).

Figure 8 and 9 show two how ecosystem services influence human wellbeing, while Figure 9 expands the former figure by adding an economic component of those welfare gains or losses. Having a closer look at both figures, one realizes that the categorization and labeling of the natural sphere differs, an issue which I will discuss below.

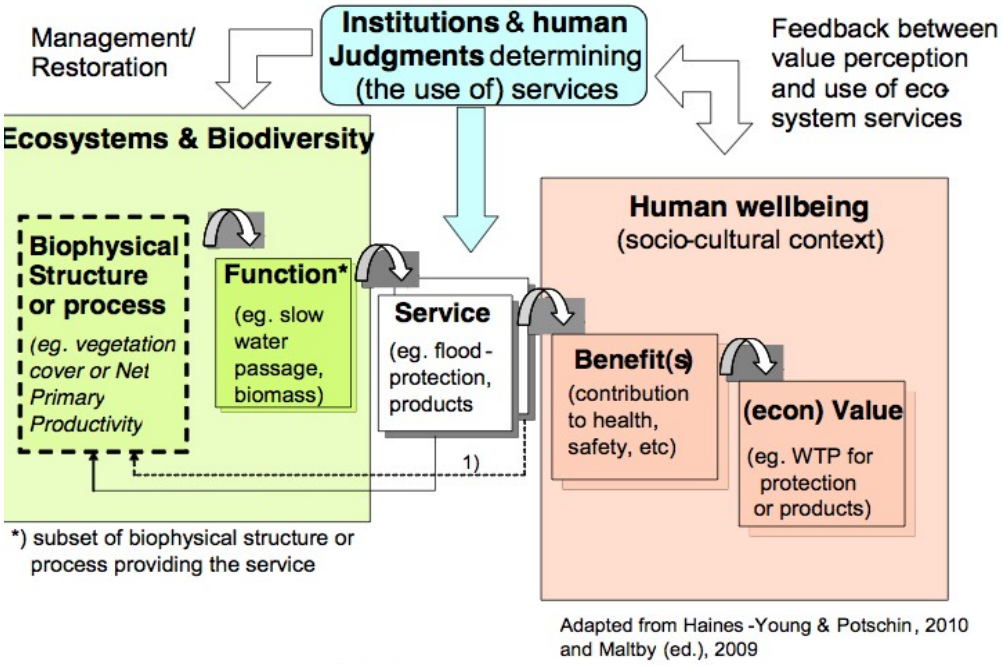


Figure 9: TEEB framework illustrating the relation between ecosystem services and biodiversity with human wellbeing (Kumar 2010:10)

Different authors date the recognition of natural commodities value to different points in time. Gómez-Baggethun et al. (2010, Gómez-Baggethun / Ruiz-Pérez 2010:106ff., Gómez-Baggethun / Ruiz-Pérez 2011; compare Kumar 2010:7) trace the origins to the end of the 1970s and the 1980s. Washington (2013:27) dates the first description of ecosystem services to the 1960s. In contrast Costanza et al. (2011:3) date the explicit reference to ecosystem services to a publication by Ehrlich and Mooney in 1983. However, Gómez-Baggethun et al. (2010) point out that ancient civilizations already realized the value of the environment to sustain and promote human wellbeing and the negative effects of its degradation.

Classical economic theory[54] provides us with interesting insights concerning human-nature relations. According to Gómez-Baggethun et al. (2010) economists of that time did not put a value

54 Classical economics can be seen as a theory which has many things in common with *Ecological Economics*. Daly (1996:4ff.), for example, connects his idea of a steady state economy with the theories of classical economics, stating that due to the natural limits economy would automatically end in steady state. Generally it can be stated that both schools of thought are connected by their emphasis on the natural environment, which limits economic growth (Daly 1996:4, Munda 1997: 213f., Common / Stagl 2005:2).

on ecosystem services as such, but generally understood services provided by nature as non-substitutable gifts. Hence, although economists did not attach a certain economic value on it, the environment had a special role within economic analysis. This changed with the Industrial Revolution and the formation of neoclassical economy, where land more and more became a substitutable factor. Now the focus is on the production factors land and capital and on monetary valuation as a common denominator to express exchange value. All factors that do not directly contribute to the creation of exchange value were excluded. This again changed in the middle and second half of the 19th century, when the positive contributions of non-marketed environmental commodities were analyzed and subsequently internalized, and *Natural Resource Economics* and *Environmental Economics* were born. In the second half of the 19th century the second economic school of thought examined in this thesis, *Ecological Economics*, was institutionalized, offering another approach to the (economic) analysis of ecosystem services (Gómez-Baggethun et al. 2010).

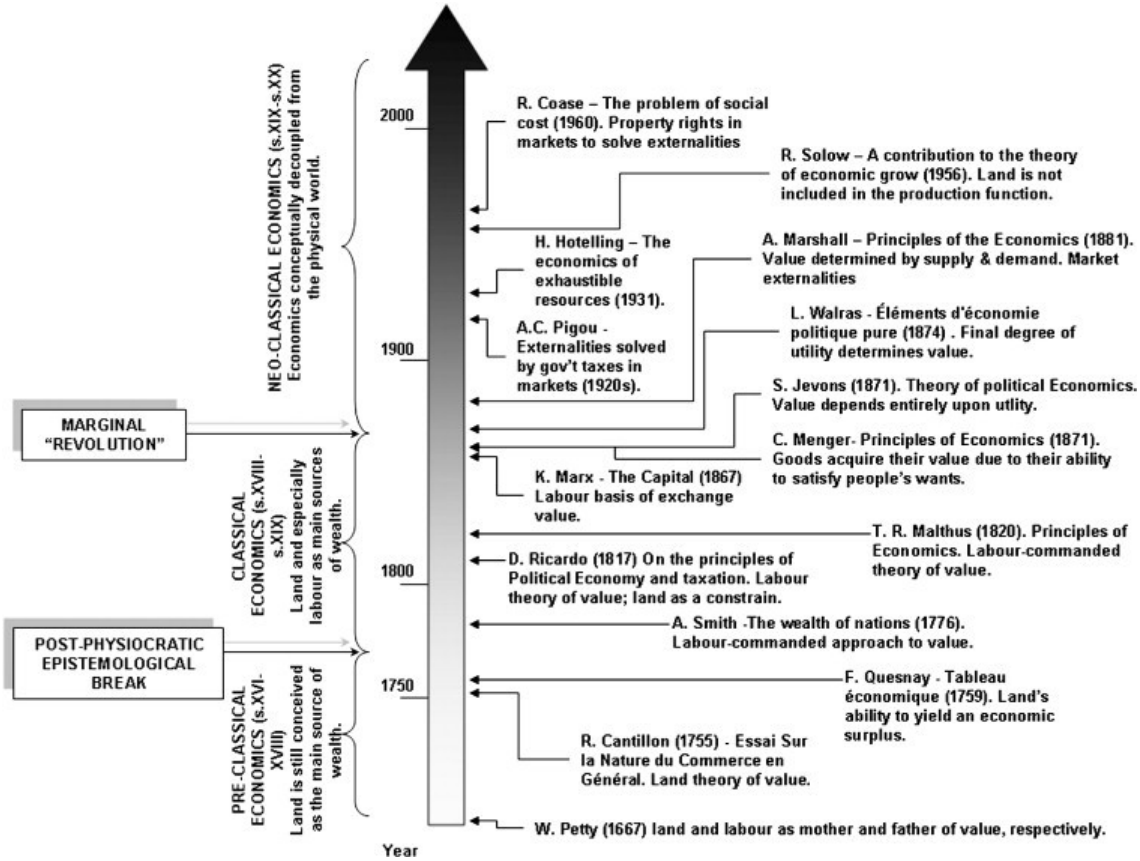


*Figure 10: Milestones in identifying ecosystem services (*Gómez-Baggethun et. al 2010:1210).

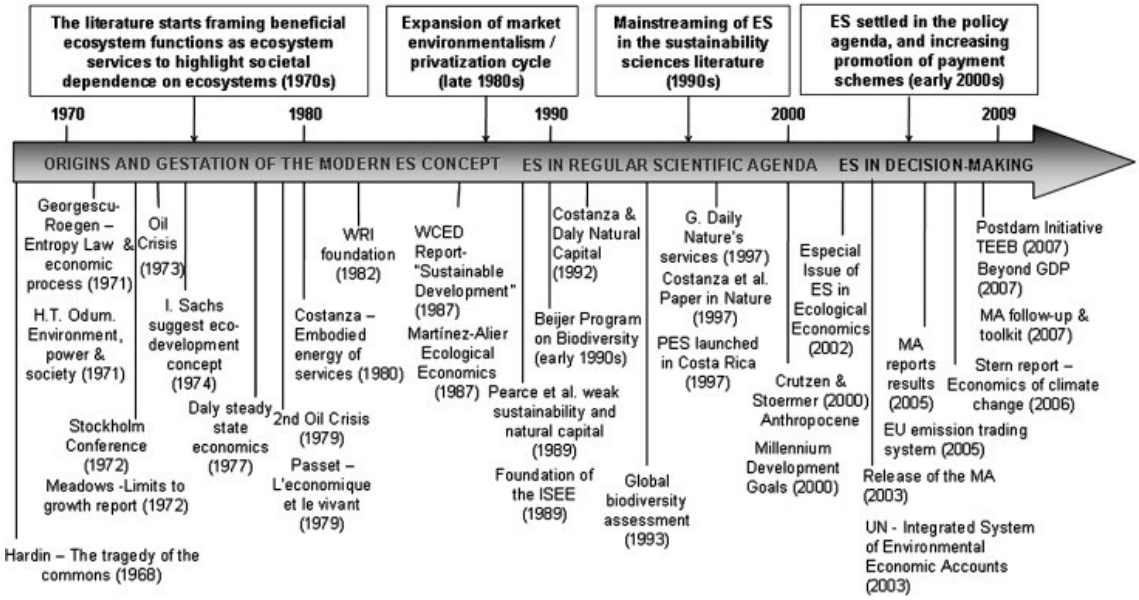


*Figure 11: Stages in the modern history of ecosystem services (*Gómez-Baggethun et. al 2010:1213).

Gómez-Baggethun et al. (2010) identified three different stages of modern ecosystem service science (see Figure 11): origins and gestation, mainstreaming and emergence in markets. The first stage started in the 1960s and ended in the 1980s and is the period in which the value of ecosystem services for human wellbeing was again discovered. In this time illustrating the economic value of ecosystem services was not a priority. "The rationale behind the use of the ecosystem - service concept was mainly pedagogic, and it aimed to demonstrate how the disappearance of biodiversity directly affects ecosystem functions that underpin critical services for human well-being" (Gómez-Baggethun et al. 2010:1213). In the second stage the concept of ecosystem services had its breakthrough. Publications that attracted the attention of a greater audience were Costanza et al. (1997), who did one of the first estimates of the total economic value (TEV) of global ecosystem services, the Millennium Ecosystem Assessment (MEA) and the Economics of Ecosystems and Biodiversity (TEEB) (Gómez-Baggethun et al. 2010, Gómez-Baggethun / Ruiz-Pérez 2011). Gómez-Baggethun and Ruiz-Pérez (2011:919f.) present a list of international institutions and initiatives that used the ecosystem service approach (see Figures 12 and 13). The third stage identified by Gómez-Baggethun et al. (2010) is the phase in which the identification of ecosystem services found its manifestation in the market system. Markets for Ecosystem Services (MES) developed where the monetary transactions to either compensate for the loss, like the Polluters Pay Principle (PPP) or Payments for Ecosystem Services (PES) take place.

Gómez-Baggethun et al. (2010, see also Gómez-Baggethun / Ruiz-Pérez 2011:620, Kumar 2010) state that before ecosystem services are actually traded on a market three other steps have to be

run through. These steps are economic framing, monetization, and appropriation. A fourth and last step, commercialization, is the step where the environmental commodities are traded in one way or another. The three preliminary steps describe the recognition of the influence of certain environmental commodities to human wellbeing, their subsequent classification and description, the actual (monetary) valuation of these commodities and the attribution of property rights.

Before I expand on MES and the different approaches which are employed for the purpose of internalization, I will further expand on the classification of ecosystems services referring to MEA and TEEB.

MEA and TEEB greatly influenced the discussion about ecosystem services, bringing them into the center of attention (Gómez-Baggethun et al. 2010, Costanza et al. 2011:3). Gómez-Baggethun et al. (2010) state that MEA's main contribution was that they did not only focus on the service side of ecosystems but also on their functions that allow and promote the provision of services. Hence, although having an anthropocentric perspective, the general role of biodiversity and ecological processes was highlighted. The report not only illustrated the role of ecosystems for humans but also pointed out ecosystem destruction resulting from human actions and advice that fundamental change of human behavior is necessary (Costanza et al. 2011:3). The role of MEA is also highlighted by TEEB: “The introduction of the concept of ecosystem services on the global agenda by the MA provides an important bridge between the imperatives of maintaining biodiversity and the challenges in meeting the Millennium Development Goals” (Kumar 2010:7). In contrast to TEEB, MEA did not focus on illustrating the economic value. However, they for example present a table illustrating the gross national investment (GNI) adjusted for investment in human capital, depletion of natural resources and pollution damages. Also, the economic benefits and monetary value of certain ecosystem services are discussed (MEA 2005:55f.).

In contrast TEEB does focus on monetary valuation (Gómez-Baggethun et al. 2010). Even though monetary valuation is the core task of TEEB, the initiative also has a certain educative function, again pointing to the general importance of ecosystem's services on humanity. Moreover, apart from monetary valuation they also promote the use of other indicators as a preliminary step. And although CBA is the main tool for TEEB to reflect costs and benefits, they also indicated that multi-criteria analysis (MCA) can be used, if the benefits of the three levels – ecological, socio-cultural and economic – are compared (Kumar 2010).

Project	Main institutions	Aim	Webpage
Millennium Ecosystem Assessment (MA)	United Nations Environment Program (UNEP), Convention on Biological Diversity (CBD), and many other international organizations	Assessing ecosystem changes and the consequences for human well-being, at scales from global to local	http://www.millenniumassessment.org/
The Economics of Ecosystems and Biodiversity (TEEB)	United Nations Environment Program (UNEP), German Federal Ministry of the Environment, Department for the Environment, Food and Rural Affairs (DEFRA), European Commission (EC)	To draw attention to the global economic benefits of biodiversity and to highlight the growing costs of biodiversity loss	http://www.teebweb.org/
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)	United Nations Environmental Program (UNEP), Food and Agriculture Organization (FAO), International Union for Conservation of Nature (IUCN), International Institute for Sustainable Development (IISD)	Act as an interface between the scientific community and policy makers that aims to build capacity for and strengthen the use of science in policy-making	http://www.ipbes.net/
System of Integrated Environmental and Economic Accounting (SEEA)	United Nations (UN), European Commission (EC), International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD), World Bank (WB)	Create a common framework to measure the contribution of ecosystems to the economy and the impact of the economy on ecosystems	http://unstats.un.org/unsd/envaccounting/seea.asp

Figure 12: International initiatives incorporating the ecosystem services approach (Gómez-Baggethun / Ruiz-Pérez 2011:919)

Project	Main institutions	Aim	Webpage
Beyond GDP	European Commission (EC), European Parliament, The Club of Rome, World Wide Fund for Nature (WWF), Organization for Economic Co-operation and Development (OECD)	To develop and improve widely applicable indicators to assess social, economic, and environmental progress	http://www.beyond-gdp.eu/
Ecosystem Services Partnership (ESP)	Environmental Systems Analysis Group (Wageningen University), the Institute for Ecological Economics (Portland State University), the Netherlands Environmental Assessment Agency and up to 40 other core and full members	To build a network to enhance and encourage a diversity of approaches in the application of ecosystem services to promoting better science, policy, and practice	http://www.fsd.nl/esp
The Ecosystem Services Expert Directory	World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD), Ecological Society of America (ESA), International Union for Conservation of Nature (IUCN), Earth Watch Institute (EWI)	To serve as a resource for policy-makers and professionals looking for information or guidance on a particular ecosystem trend or management practice	http://projects.wri.org/ecosystems/experts

Figure 13: International initiatives incorporating the ecosystem services approach (Gómez-Baggethun / Ruiz-Pérez 2011:920)

TEEB issued many other publications which focus on different stakeholder groups and different scales of implementation and different ecosystems. (TEEB) TEEB's work is an ongoing process and thus TEEB continuously focuses on different aspects of ecosystem service valuation.[55]

Ecosystem services or nature's services differ from natural capital. Natural capital is the stock of organic and inorganic material that provides us with the goods and services that we need for survival (Costanza et al. 2011, Gómez-Baggethun / Ruiz-Pérez 2010:109). Ecosystem services can be also distinguished from ecosystem functions and ecosystem processes. The functions and processes differ, as they do not directly provide humans with benefits. Functions and processes can contribute to services but they are not the same (Costanza et al. 1997:253, Costanza et al. 2011). TEEB further distinguished between ecosystem functions, structures and processes (Kumar 2010:19, Gómez-Baggethun / Ruiz-Pérez 2010:109ff.).

The goods and services that are provided by the ecosystem are usually simply termed ecosystem service (Gómez-Baggethun / Ruiz-Pérez 2010:111). "[Ecosystem services] maintain biodiversity and the production of ecosystem goods such as seafood, forage, timber, biomass fuels, fiber, medicines and industrial products. Ecosystem services are the actual life-support functions such as cleansing, recycling, and renewal, that also confer on humanity intangible, non-material, aesthetic, spiritual and cultural benefits" (Washington 2013:28). The concept of ecosystem services is thus a very complex one, which is subdivided and classified differently by different institutions and initiatives.

The MEA (MEA 2005:40) distinguishes between four different categories: provisioning services, regulating services, cultural services and supporting services. How these four categories of services are supposed to promote human wellbeing is depicted in Figure 8. The understanding of ecosystem services is generally an anthropocentric one. Goods and services are identified through the benefits which they deliver to humans. The concept of ecosystem services does not analyze how goods and services benefit other species (Washington 2013:28, Costanza et al. 2011:2). However, this anthropocentric perception is circumnavigated through the fourth category, supporting services. This last category illustrates that the ecosystem itself needs to be balanced in order to be able to deliver services to humans. Thus supporting services only promote human wellbeing indirectly (Washington 2013:28).

TEEB does categorize ecosystem services differently, as can be seen by comparing Figures 8 and

55 For more information see TEEB's webpage (TEEB[2]).

9. Washington (2013:27ff.) provides a comparison of MEA's and TEEB's ecosystem classifications. TEEB also distinguishes four types of ecosystem services: provisioning services, regulating services, cultural services and habitat services. Washington (2013:33) points out that the major difference can be found in the last two categories. Supporting services were substituted with the category habitat services, while Washington (2013:33) criticizes that supporting services were excluded and classified as ecosystem process and thus they are no longer services (Kumar 2010). Concerning the cultural services category, Washington (2013:34) states that TEEB downgraded the importance of intrinsic values.

In the TEEB report it is pointed out that categorization is necessary and important to, for example, avoid double counting. However, it is also admitted that no agreement on how to classify ecosystem services exists (Kumar 2010, Gómez-Baggethun / Ruiz-Pérez 2010:109ff.).

TEEB distinguishes between services and benefits and concerning benefits, they further distinguish ecological, socio-cultural and economic benefits. Moreover, they separate value from benefit, since ecosystem services can have many benefits and their valuation is again a different thing. Only the economic benefits are measured in monetary terms, although they employ TEV. Other benefits can be measured with other qualitative and qualitative indicators (Kumar 2010:24f.).

Since the understanding of what is a function, a process or a service is a bit blurry, I rather used the term environmental or natural commodities. One can indeed distinguish processes from functions and services, and indeed, in order to increase knowledge and awareness concerning the role of the environment in providing and promoting human wellbeing and in order to choose the most appropriate valuation method and to avoid double counting, it is needed and helpful. Anyway, concerning the economic analysis and given that so far the anthropocentric utility based approach to valuation is applied, what matters is the actual commodity. Of course, using the term service does better promote the understanding that nature is more than just a commodity that can be traded on a market. But again, at the end of the day, after processes are divided from services and after particular goods and services are identified, they are valued monetarily and ultimately commodified.

10.2. Polluter Pays Principle and Payments for Ecosystem Services

After acknowledging that environmental commodities do influence human wellbeing and thus have a value, two different approaches can be employed to undertake a monetary transaction. These two are Polluter Pays Principle (PPP) or Payments for Ecosystem Services (PES). The major difference between the two is that in case of PPP the polluter has to pay, while in case of PES the

recipients of a service pay.

Gómez-Baggethun et al. (2010, see also Gómez-Baggethun / Ruiz-Pérez 2011:618) state that one can distinguish between MES and PES. I would rather say that one has to distinguish between PPP and PES. Sattler and Matzdorf (2013) also indicate that the relation between PES and MES remains fuzzy. I would argue that PPP and PES are institutionalized through MES (compare Kumar 2010). MES are platforms where an economic agent has to pay a certain price in order to be allowed to pollute (e.g., though tradable permits) or where they pay for the provision of a service. That we rather distinguish PES and PPP is also supported by Mauerhofer et al. (2013). Duraiappah (2007) delivers a definition of MES:

> MES are defined as mechanisms that create a market for ecosystem services in order to improve the efficiency in the way the service is used. A market is defined as a mechanism that allows people to trade, normally governed by the theory of supply and demand; by allocating resources through a price mechanism those willing to pay a price for something meet those willing to sell at that price. Examples of MES include the establishment of carbon sequestration offsets, tradable development rights, tradable quota systems, eco-labelling and environment-certification and bio- prospecting, among others. (Duraiappah 2007:4)

Duraiappah (2007) further provides some examples of MES implemented so far and explains criteria that should be fulfilled when a MES is designed.

Gómez-Baggethun / Ruiz-Pérez (2011:618, see also Mauerhofer et al. 2013) state that PPP has been incorporated in legislation since the 1980s and is based on the responsibility of polluters to compensate their destructive actions. They give a short historic[56] overview of the national supranational and international treaties that incorporated PPP. One of the most prominent examples of a PPP is the *Kyoto Protocol*'s carbon trading scheme. So basically on the MES tradable permits are issued which allow every holder of the permit to emit a certain amount of pollution at a certain cost. If the holder of the permit needs fewer permits than allotted, one can trade it on the respective MES with those who need more (Mauerhofer et al. 2013, Duraiappah 2007:5).

PES[57] are based on the concept that those who profit from ecosystem services should pay for the provisioning of the respective service. In contrast to PPP, PES are voluntary actions which include at least two parties (Gómez-Baggethun / Ruiz-Pérez 2011, Gómez-Baggethun et al. 2010, Mauerhofer et al. 2013, Sattler / Matzdorf 2013). Gómez-Baggethun and Ruiz-Pérez (2011:618f. compare Mauerhofer et al. 2013, Sattler / Matzdorf 2013) date the implementation of PES to the

56 For a more thorough discussion of the history and development of PPP see Munir (2013).
57 For an overview of PES definitions, categorization and phases in the PES design see Sattler and Matzdorf (2013).

1930s. PES have been implemented on a bigger scale in Costa Rica since the mid of the 1990s and through mechanisms related to the *Kyoto Protocol* and the United Nations Collaborative Program on *Reducing Emissions from Deforestation and Forest Degradation* in Developing Countries (REDD and REDD+) (Sattler / Matzdorf 2013:5).

PPP address what is called negative externalities, externalities which have a harmful impact. On the other side there are positive externalities, which have a positive impact on wellbeing, which are captured by PES (Gómez-Baggethun / Ruiz-Pérez 2011:618). Mauerhofer et al. (2013) point out that PES are on the rise since they have some advantages in contrast to PPP. There are two major drawbacks of PPP. First, they need legislation determining the framework of pollution control, which further entails proper enforcement. Second, a threshold has to be defined, which when violated is third, connected to a *fine*. In order to set a threshold it has to be known where this is, which is not always that easy. The third issue again is connected to several problems. For example the fine has to be high enough; otherwise some polluters will simply prefer paying the fine. Another problem evolves if the polluter is not able to pay the fine or if the resulting damage cannot be compensated monetarily. Mauerhofer et al. (2013) state that especially in developing countries[58] PES are preferred, since some say that they do not need proper legislation and enforcement. However, generally Mauerhofer et al. (2013) argue that a combination of both would be best, where PPP is complemented and supported by PES measures.

The compliance of legislation is connected with monitoring, which is not only necessary for PPP but also for PES. Apart from difficulties related to monitoring, PES also have some shortcomings, which are connected to the challenges in estimating the opportunity costs, high transaction costs, inappropriate claims or more fundamental questions regarding the basic right to consume ecosystem services. The latter is related to the question of whether it is justifiable that people have to pay for ecosystem services that cover their basic needs. Concerning inappropriate claims, different aspects have to be taken into consideration. First, institutions can apply measures to protect ecosystem services. Such measures entail expropriation, which might not be compensated adequately. Second, institutions might claim extremely high amounts for the potential loss of ecosystem services. Mauerhofer et al. (2013) thus conclude that PES need an underlying legislation that predetermines "[...] an ecologically sustainable scale alongside a socially just distribution" (ibid.:2). Similarly, Duraiappah (2007:5) emphasizes the role of governments to set up the framework conditions of MES. Sattler and Matzdorf (2013) explain that PES can be understood either following the Coasian solution (see below), which is market based, or as a measure which is completed by governmental regulations, after Pigou's suggestions. Sattler and Matzdorf (2013),

58 In developing countries so called Pro-poor PES are promoted (Sattler / Matzdorf 2013, Duraiappah 2007).

analyzing the PES in place, conclude that in reality PES following the Coasian solution are the minority.

In the following I will expand on approaches that are used in order permit a monetary transfer from either a polluter to an institution or from a consumer of ecosystem services to the managers or safeguards of respective service.

10.3. Approaches to internalization: Market-based solutions versus government policies

Asafu-Adjaye (2005:77ff.) presents a comprehensive introduction of the approaches used for internalization (see Figure 14, see also Venkatachalam 2007:550, Common / Stagl 2005:404). In short, two major approaches can be distinguished:

- property rights or market solutions: this approach leaves the problem solving entirely to the market system; hence government intervention would not be needed in order to solve environmental problems. This kind of solution was first proposed by Ronald Coase (Asafu-Adjaye 2005:77, Pearce 2002:61, Common / Stagl 2005:328f.).
- government intervention[59]:
  - market based intervention (MBIs)
  - command and control instruments (CAC) (Asafu-Adjaye 2005:77, Gómez-Baggethun / Ruiz-Pérez 2011:618).

One can also distinguish between price and quantity based instruments. The former regulates pollution through the price mechanism, but does not set a limit for emissions (MBI). The latter in contrast sets limits to the overall amount of emissions allowed (CAC). Which of the two is chosen depends on the shape and the uncertainty of the marginal cost and benefit curves (Pindyck 2007:53).

As can be seen in Figure 14, the approaches can be further divided. However, all approaches have advantages and disadvantages and thus there is no one-size-fits-all solution and the appropriate method has to be chosen according to the problem at hand. Pearce (2002:75) points out the huge influence of environmental economists in getting their ideas adopted. He states that, however, “[...] it remains surprisingly unclear just how successful the instruments have been themselves. There is a great need for more *ex post* study of the effectiveness of economic instruments” (Pearce 2002:75).

59 For an overview of such methods applied to land management see Ibrahim et al. (2012:27ff.)

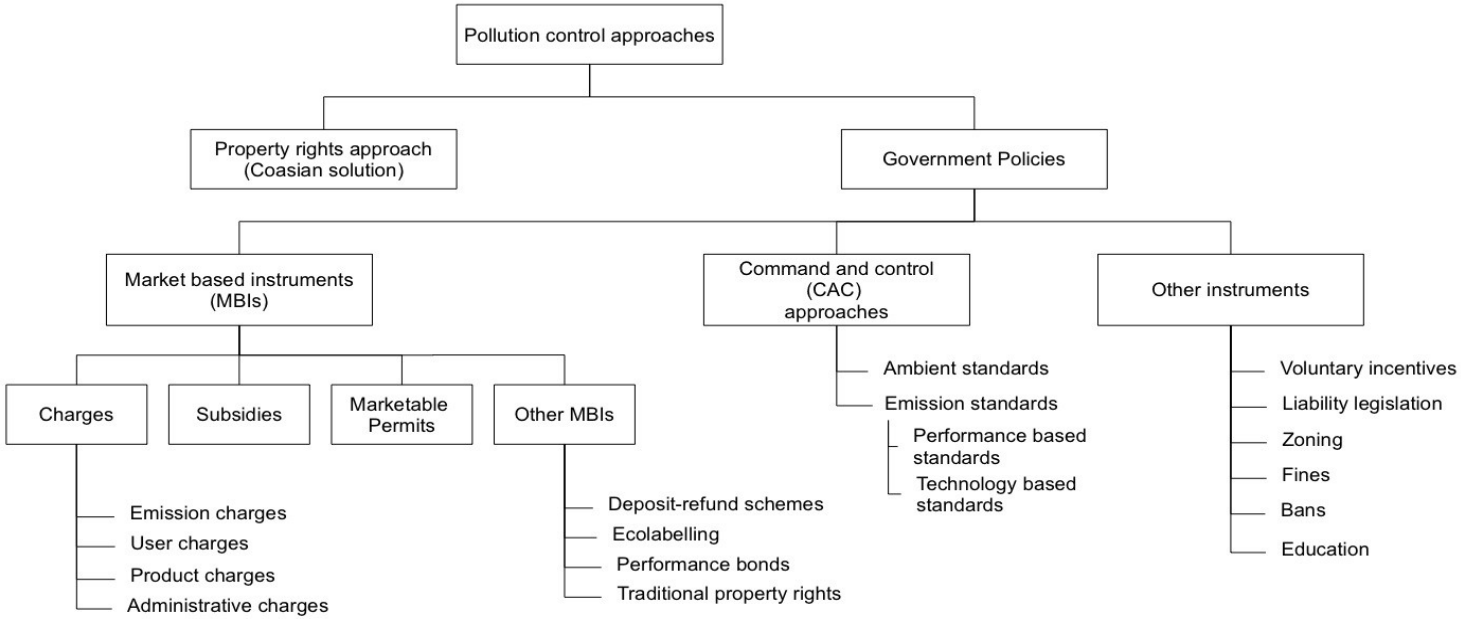


Figure 14: Pollution control approaches, after Asafu-Adjaye (2005:78)

10.3.1 Market-based solution: the Coasian Solution

In his paper *The Problem of Social Cost* Ronald Coase further developed the Pigouvian tax idea. Not only could the polluter pay compensation to third parties, also the third party could pay the potential polluter for not pursing pollution. The second case sounds a bit unrealistic, but is suggested in cases where the polluter depends economically on the polluting actions[60] (Pearce 2002:61).

The *Coasian Solution* suggests solving environmental problems through the market system. Thus through the bargaining process of involved parties a Pareto efficiency is achieved. The precondition for this method to work is clearly defined property rights. The costs and benefits for environmental protection of the involved parties are estimated. Like for the demand and supply curve discussed above, it is assumed that, for example, the society is willing to pay a certain amount of money in order to preserve an environmental good. On the other side, a producer is willing to pay a certain amount of money in order to be allowed to pollute the environment to a certain degree. Where the curves intersect the equilibrium price is found. Whether the society has to pay or gets paid compensation depends on the respective distribution of property rights. For the equilibrium to be reached it does not matter who, the polluter or the affected third party, has the property rights. It does, however, change the distribution of costs and benefits. If the polluter has the property rights, the affected party needs to pay the polluter to reduce harmful actions. So the affected need to pay for the “right” to a cleaner environment. If the affected have the property rights the polluter has to pay for the right to pollute. This solution implies that the market solution does not necessarily lead to zero pollution, since the population might accept a certain degree of pollution (Asafu-Adjaye 2005:78ff., Pearce 2002:61, Wiesmeth 2012:82, 98ff., Common / Stagl 2005:328f.).

However, property rights need to be assigned clearly, which is impossible for some environmental goods (Wiesmeth 2012:78). Even if property rights are assigned clearly, a bargaining process might not lead to an efficient allocation (Wiesmeth 2012:94). Moreover, if the bargaining process is connected to high transaction costs, it is unlikely that the *Coasian Solution* will be applied (Wiesmeth 2012:100).

Even if the *Coasian Solution* provides a way of dealing with environmental problems through the marketplace, the underlying conditions[61] make it hard to apply (Asafu-Adjaye 2005:81f., Pearce

60 See for example Yasuni National Park (Cool Earth, Fridjof Nansen Institute 2008).

61 Zero transaction costs, well-defined property rights, perfect competition, no income (or wealth) effects, no free-rider effects.
Perfect competitive markets: if the market is not perfectly competitive the producer sets the supply curve

2002:61, Common / Stagl 2005:329).

10.3.2. Government policies

Neoliberal economy does not promote governmental intervention, since this is deemed to cause market distortions (Gowdy / Olsen 1994:164f., Ress 2001:1). The role of the government should thus be limited to providing proper framework conditions in order to allow the market to work efficiently. However, within *Environmental Economics* the role of the government is amended. As already pointed out, the market *per se* does not have an inbuilt sensor that detects natural resource scarcity and thereby start by itself to raise prices accordingly. The same is true for pollution. The market is an institution made by humans and therefore humans decide what is traded on the market and what is not. External costs of pollution, for example, are not included in prices of goods traded on the market. This fact justifies governmental intervention (Pearce 2002:58). As Daly (1996:14ff.) points out, it is the inability of the market mechanism to inhibit environmental degradation which results in the need for governmental intervention.

As illustrated above, government policies[62] can be subdivided into command and control (CAC) instruments and market-based instruments (MBI), both of which can be subdivided even further. Asafu-Adjaye (2005:95) points out that since there are a lot of possibilities to choose from, governments have to check them for each specific situation for their efficiency, effectiveness, adaptability, equitability and political acceptance. For efficiency, the aggregate costs and benefits need to be evaluated. Asafu-Adjaye (2005:97) suggests that since both MBI and CAC mechanisms have advantages and disadvantages, they should be combined. Generally he states MBIs have the advantage of giving an incentive to reduce pollution rather than just punishing the polluters. One common problem is the lack of information about the market structure. This has consequences for the efficiency of methods applied. Wiesmeth (2012:127ff., see also Common / Stagl 2005:417, 429ff., Müller 2001:425) expands on that issue, concluding that "[e]nvironmental policy has […] to do without reliable first-hand information on preferences, marginal profit and marginal damage curves, or has to try to gather at least some of the required information through other channels and other methods" (Wiesmeth 2012:131).

not according to the marginal cost, but rather to the marginal revenue, which is not an efficient allocation. Hence the whole calculation is distorted (Asafu-Adjaye 2005:75f.,82).
Income effects: The transfer of property rights has effects on the pollution reduction. Additional wealth is created due to the transfer of assets. If the affected party gets the property rights the equilibrium will be shifted right (calling for more abatement); if the causer has the rights, then it will be shifted left (less abatement) (Asafu-Adjaye 2005:82).
Free ride effect → many parties have to negotiate → every affected party wants the other party to bear the cost, or every producer wants that another producer bears the costs (Asafu-Adjaye 2005:83).

62 For MBIs as well as CACs applied to land management, see Ananda / Herath 2003.

10.3.2.1. Command and control instruments

Command and control (CAC) instruments is a commonly used measure in regulating environmental pollution (Pearce 2002:72, Wiesmeth 2012:135, Common / Stagl 2005:410). As the name of this instrument reveals, the government is setting standards, which sometimes implies dictating which technology to use in order to comply with it. The control part of the measure indicates that compliance is certainly monitored (Pearce 2002:73, Asafu-Adjaye 2005:83).

Asafu-Adjaye (2005:84, see also Common / Stagl 2005:411ff.) presents a categorization of CACs:

- Ambient standards: These comprise, for example, minimum level of water or air quality, or the maximum amount of pollutants in the environment. Compliance is controlled indirectly through emission controls.
- Emission standards: They define the maximum emissions.
- Technology standards: These standards determine the technologies or practices that must be adopted.

There are some advantages as well as disadvantages to CACs. One advantage is that they are efficient and pragmatic. Once a CAC is installed it is clear that the goal set will be achieved. The result of the policy is not left open for market mechanisms. Van den Bergh (2000:55), questioning the consumer choice theory, emphasizes that CACs might be the preferable means since they are not that dependent on the market mechanism. Alcott (2008), analyzing the IPAT identity and the influence of the affluence variable, points out that it might be easier to tackle the problem from the left-hand side of the function. Due to the complexities and interrelations (like rebound effects) between the right-hand side variables, regulations focusing on them might not be effective. Moreover, in case no or weak information about the market configuration is available a CAC can be the only useful measure. CACs thus conform with the precautionary principle. The standard targets are set in physical units, which makes the assignment of monetary values superfluous. Installing a CAC can also be a clever move of politicians hunting for voters (Asafu-Adjaye 2005:86, Wiesmeth 2012:135ff., Common / Stagl 2005:404, 410). Asafu-Adjaye (2005:85, 140f.) comes up with the antithetic argument, stating that implementing a CAC can cost votes.

Wiesmeth (2012:136) makes an interesting point, arguing that through CACs, economic and environmental goals are separated, which opposes *Environmental Economics*' intention. Since CACs only demand the implementation of a standard, there is no incentive to do more than that. Additionally, if the technology that has to be employed is stipulated, technological innovation is not promoted. This can be avoided by setting a standard for the pollution level rather than dictating how this is achieved. The costs to implement the measure can be high for governments

(monitoring) as well as for companies, while the uniformity of the costs can mean a substantial economic disadvantage for some companies. Fines for noncompliance have to be high enough to persuade companies to implement the measure. To this end but also to set an optimum standard, demand and supply curves have to be known, which is often difficult. Therefore standards will probably not be optimal, whereby market distortions follow. Moreover, standards need to be revised regularly due to changing circumstances (Asafu-Adjaye 2005:85f., Wiesmeth 2012:142, Common / Stagl 2005:411).

10.3.2.2. Market-based instruments

In contrast to CAC market-based instruments do intervene through market incentives and regulations. The supposed advantages of these methods are that through the market mechanism abatement costs are reduced and technological innovation is promoted. Thus MBIs are a decentralized means and it is up to the economic agents to decide whether an environmentally harmful activity is further pursued. Stavins (2007:9) criticizes CAC measures, since depending on the circumstances, they are probably not cost-effective. “In theory, market-based instruments allow any desired level of pollution cleanup to be realized at the lowest overall cost, by providing incentives for greatest reductions in pollution by those firms that can achieve the reductions most cheaply” (Stavins 2007:9). Stavins (2009:9f.) further argues that in contrast to CAC measures, the MBIs lead to the equalization of the marginal abatement cost and even provide incentives to diminish abatement cost, through cheaper and more efficient technologies.

MBIs entail charges, subsidies, marketable permits, deposit refund schemes, performance rating or environmental caps (Asafu-Adjaye 2005:86, Pearce 2002:73, Common / Stagl 2005:405, Wiesmeth 2005:183f.). MBIs are not as famous as CACs due to the disadvantage MBIs have. It is, for example, not assured that a MBI has the anticipated pollution control effect. They are also more costly than a CAC. If, for example, a tax is levied enterprises have to pay the tax and have to bear abatement costs in order to reduce pollution. Moreover, for setting an optimal tax level, demand and supply curves have to be known, which is difficult to evaluate for environmental commodities (Common / Stagl 2005:405f., 430, Wiesmeth 2005:136, Costanza et al. 1997:257).

There is a multitude of other market based instruments that are not further discussed here. Still, I want to mention some: eco-labeling, performance bonds, and traditional property rights (Asafu-Adjaye 2005:92).

Eco-labeling is a measure giving the consumer more information. Additionally, a label might increase market access (Asafu-Adjaye 2005:94, Ibrahim et al. 2012:25f.). Performance bonds are

similar to deposit-refund schemes (discussed below), but it is about complying with governmental regulations after an economic activity that caused pollution took place (Asafu-Adjaye 2005:94). Traditional property rights have proven to be more successful than quota regulations. This is due to the ownership over the resources and the incentive to preserve them (Asafu-Adjaye 2005:94f.). Subsidies for reducing pollution or for buying technology are criticized because they can in the long run cause more pollution, if the access to subsidies is not regulated strictly. It is also a social debate, because money is transferred to polluters, while charges would generate income (Asafu-Adjaye 2005:88f.). Pender (1998:101f.) argues that subsidies are a good policy measure, particularly when poverty is involved. He states that taxes or regulations that force people to adhere can have negative effects on poverty reduction. Subsidies, in contrast, can serve the goal of environmental protection and poverty mitigation.

Pollution taxes - Pigouvian Tax

The idea of taxing environmentally harmful activities dates back to Arthur Pigou. The difference between the individual benefits of an action and the resulting costs for society are offset through a tax (Asafu-Adjaye 2005:86, Pearce 2002:73, Wiesmeth 2012:84, Common / Stagl 2005:415).

Arthur Pigou was the first to discover that the market mechanism, even if it works under perfect conditions, does not lead to an optimal state. He realized that under certain conditions the consumption of one economic agent can affect others and can probably have adverse effects on social welfare (mind the difference between increasing personal welfare through consumption and increasing overall social welfare!). Through introducing a tax on pollution, enterprises will react with pollution control up to the limit where the marginal abatement cost is equal to the tax (Pearce 2002:73). Müller (2001:419) points out that since Pigou's suggestion governmental intervention became more accepted in mainstream economics. Stavins (2007:11) criticizes the tax instrument as being more costly than CAC since enterprises have to pay abatement costs and the tax. Pearce (2002:73) points out that taxes are unpopular because enterprises have to pay for optimal and non-optimal pollution, while CACs only charge for non-compliance with standards. Emission taxes are based on the polluter-pay principle (Asafu-Adjaye 2005:87, Wiesmeth 2012:87). The *Environment Directorate at the Organisation for Economic Co-operation and Development* (OECD) formulated the “Polluter Pay Principle” in 1970s and is thus an advocate of pollution taxes (Pearce 2002:64).

Pollution taxes face, like CACs, similar problems concerning market information. Government needs to know demand and supply curve, which is impossible, hence taxes are usually set at a level lower than optimum pollution abatement (Asafu-Adjaye 2005:87, Wiesmeth 2012:127). This

knowledge gap can result in the biggest disadvantage: the tax does not lead to a reduction in pollution. Since the decision is directed by rational market decisions, it can be economically better keeping the pollution level and paying the tax (Wiesmeth 2012:4). This is clearly the advantage of CACs where the implementation of a standard is obligatory. Similarly to CACs an institution has to monitor the pollution in order to levy the tax; therefore monitoring costs are another disadvantage. Moreover, the increased production costs are passed on to the consumer or affect employment of the enterprise negatively (Asafu-Adjaye 2005:87f.). Wiesmeth (2012:128, 185f.) indicates a further problem: avoidance strategies. Enterprises can, instead of paying the tax or paying abatement costs, look for substitutes in production. These substitutes do not necessarily have to be environmental friendly. Another issue concerning tax is the “double divided debate,” questioning what happens with the revenues levied (Pearce 2002:74).

Marketable permits

Pearce (2002:74) traces back the origin of this instrument to a work of Dales from 1968, while Asafu-Adjaye (2005:89, see also Common / Stagl 2005:426) traces it back to the US Clean Air Act from 1977. Generally the right to pollute is issued after a total amount of permits is defined. The permits are traded on a newly-established market. Permits that are not used by one enterprise can be sold to others. The aggregate amount of permits issued is defined through the socially acceptable level of pollution. The price for the permits lies at the intersection between the supply of permits and the marginal abatement cost curve. Firms that have lower abatement costs can sell their permits; enterprises with higher costs will buy them. Through this market approach, which is very flexible, it is argued that permits fulfill the criteria of being cost effective, since the price is not dictated by a central authority but through decentralized market decisions. In contrast to a pollution tax, marketable permits give quantitative, not monetary incentives. There are two different systems, the cap-and-trade scheme and the emission reduction credit scheme. The former does not allow businesses to sell or buy permits, while the latter does (Asafu-Adjaye 2005:89f., Pearce 2002:74f., Wiesmeth 2012:195f. Common / Stagl 2005:425ff.). The most well-known examples of marketable permits are issued through the *Kyoto-Protocol* (Pearce 2002:75, UNFCCC). Wiesmeth (2012:199ff., see also Common / Stagl 2005:427f.) provides some examples of marketable permits, like the *European Union Emission Trading System*.

Tradable permit schemes also have pros and cons. Advantages are that if permits are transferable, innovative enterprises can sell them. The additional income that can be generated through this is an incentive for technological innovation to cut down pollution. On the other hand the possibility to buy permits allows other enterprises not to cut down pollution immediately, while the long term incentive to reduce pollution is still given. Governments also profit from permits, since they can sell

them and generate revenue. A major advantage in comparison to pollution tax is that a maximum level of pollution is set. Hence the emission reduction will be achieved (Asafu-Adjaye 2005:90, Common / Stagl 2005:430f.).

The disadvantages are, for example, related to the basic conditions of market economy. If the market is not perfectly competitive, some enterprises might have the power to influence the price of the permits. Moreover, transaction costs can be high and compliance might be difficult to control (Asafu-Adjaye 2005:91f., Common / Stagl 2005:430).

Deposit-refund schemes

These schemes involve setting up a fund for reparation payments, in case pollution happens. Hence it is a kind of insurance that is repaid in case no pollution happened. Deposit-refund schemes do not directly target the reduction of pollutants; rather, they give an incentive to consider the adverse environmental effects an action can have in the future. They also give incentives to reduce the uncertainty in order to minimize the chance of a catastrophic event (Asafu-Adjaye 2005:92f., Common / Stagl 2005:431f.).

One advantage of this approach is that deposit-refund schemes do not need much monitoring, therefore monitoring costs are spared. This tries through monetary incentives to change the behavior of economic agents, taking a precautionary approach and trying to minimize the change of catastrophic events (Asafu-Adjaye 2005:93f.).

The disadvantage is that it is hard to determine in advance the monetary value of the possible damage. It might well be possible that the amount designated does not cover the whole cost in the end. Thus the bond should rather be over-endowed to minimize the probability that society has to bear the costs (Common / Stagl 2005:432f.).

Constanza et al. (2010), for example, show that the Deepwater Horizon oil spill probably never would have happened if a deposit refund scheme was set up. The authors indicate the disproportionality that enterprises do not have to prove in advance that their actions are not harmful. After an environmental catastrophe has happened lawsuits start, that not only cost a lot, but also take a lot of time until the case is settled. Like individuals and enterprises contract insurance to protect from various damages, the same should be done to protect society from the potential damages of an environmental catastrophe caused by the actions of an economic agent. It is argued that since enterprises do not have to bear full costs after an ecological disaster, the incentives are higher to pursue hazardous short term profits. Even if it is impossible to calculate the

exact environmental costs of the oil spill (neither *ex ante* nor *ex post)* the cost would still be high enough to change oil company's behavior. The risk of losing the money deposited would either let oil companies abstain from drilling there or to employ technologies in order to reduce the risk. Hence the probability of such environmental disasters would be much lower.

11. Environmental Valuation

Asafu-Adjaye (2005:109) states that there are two reasons why it is necessary or useful to assign a monetary value to the environment. One problem is that many environmental commodities have been assigned a zero or very low value, and thus the decisions that were made accordingly were harmful for the environment and society. Another problem concerns the occurrence of disasters caused by man. Compensation payments can only be made if an estimation of the value of the lost environment exists (Asafu-Adjaye 2005:109, Quillérou / Thomas 2012:2, Costanza et al. 1997, Kumar 2010).

However, an environmental commodity does not only have a value which results from its use, but also a value which is inherent to the commodity independent from its usage. The concept which tries to capture the overall value of an environmental commodity is the Total Economic Value (TEV). “It is defined as the sum of the values of all service flows that natural capital generates both now and in the future – appropriately discounted” (Kumar 2010).

The TEV describes the different values of a commodity that comprise its complete value. Accordingly, the TEV of a commodity is not only determined by its direct use value, but also by its non-use value. This differentiation in use and non-use values dates back to an essay of Kurtilla, *Conversation Reconsidered,* from 1967 (Kumar 2010). The difference between use value and non-use value is that from the former one can benefit directly, while from the latter only indirectly (Stavins 2007:3).

TEV is split in two subcategories:

1. use value
    - direct use value → direct use of a resource, e.g., timber production
    - indirect use value → gather mushrooms; it includes enjoying nature, wildlife, and the services that are provided by the ecosystem, water and air purification, etc.
    - option value → is the value people would be willing to pay in case the resource should be used and thus destroyed.
2. non-use value → these are values that are not directly consumed by humans, so they are

apart from a pure anthropocentric view

- existence value → appreciation of a resource /ecosystem regardless of the possibility to use it. One values its mere existence
- bequest value → the same as above, but including that the resource will persist for future generations

(Kumar, 2010, Asafu-Adjaye 2005:110f., see also Pearce 2002.70f., Pearce et al 2006:86, Costanza et al. 1997:254f.)

The difficulty of assigning a TEV is that in contrast to use values, non-use values are not traded on the market. Neglecting the non-use value should be avoided, since the share of the non-use value can be significant. Not taking it into account or under-evaluating it can lead to wrong decisions (Asafu-Adjaye 2005:111, Pearce et al. 2006:86).

Quillérou and Thomas (2012, see also Kumar 2010) present how to incorporate the TEV approach into cost-benefit analysis. They compare the costs with the benefits of land restoration. Hence they confront forgone benefits of degraded land (cost side), with the benefits that healthy land provides. A cost-benefit analysis can then be employed to evaluate whether the restoration is economically worthwhile. They assign use and non-use values to four different ecosystem services (provisioning, regulating, cultural and supportive services). Identifying all kinds of services which the ecosystem provides allows us to draw a picture which is more holistic. Which services are considered for calculation depends on the case and the aim of the analysis. However, it is not only difficult to separate the four ecosystem services from each other, but also to separate use from non-use values.

Pearce et al. (2006:86) still emphasize the significance and usefulness of separating the components of TEV:

> But differentiating use and non-use values is important because the latter can be large relative to the former, especially when the good in question has few substitutes and is widely valued. In addition, non-use value remains controversial in some decision-making contexts, so that it is important to separate it out for presentational and strategic reasons.

Apart from valuing the identified services separately and then aggregating the values, one can also value the entire ecosystem. One problem deriving from deducting the overall value from single services is that, due to the interconnectedness, the whole is more than the single parts of the whole. An advantage of this approach is that double counting can be avoided (Quillérou / Thomas 2012).

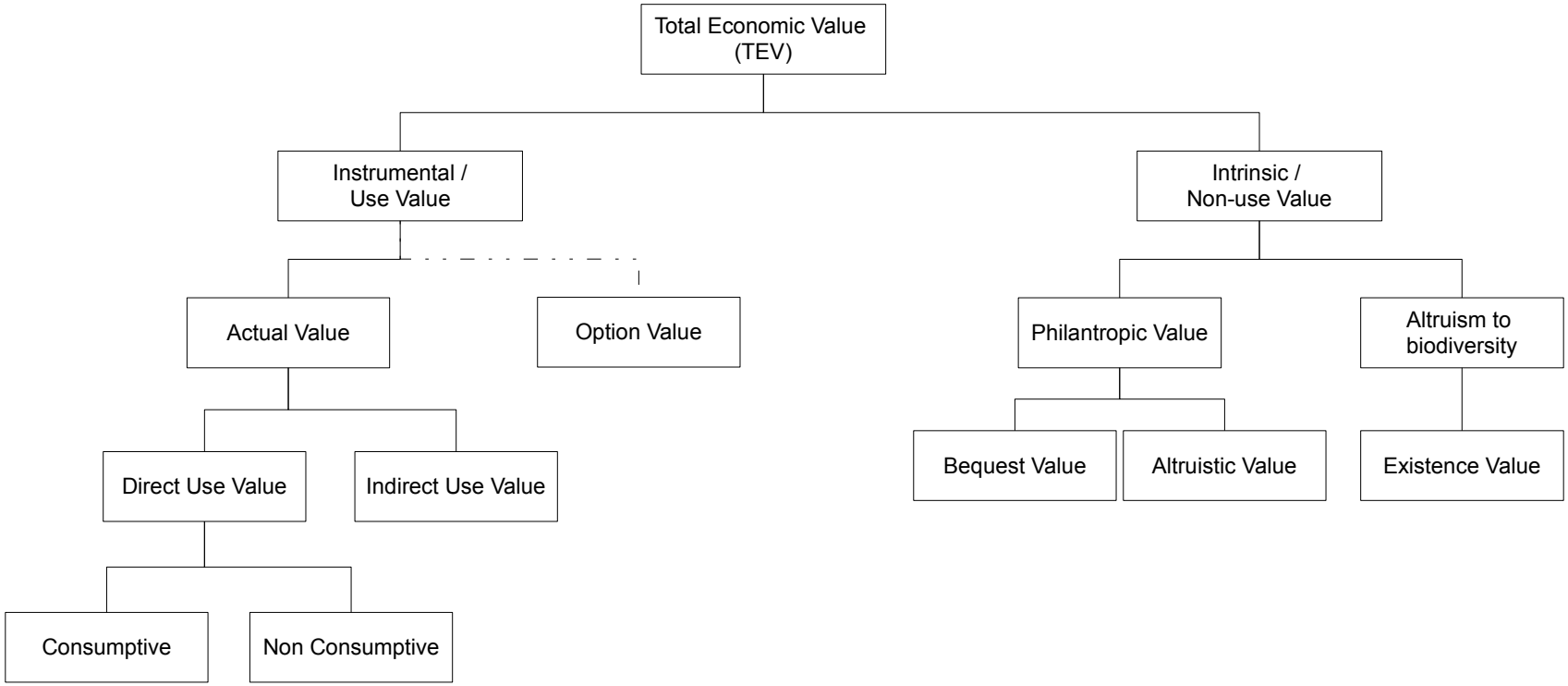


Figure 15: Components of the Total Economic Value, after Kumar (2010, compare Asafu-Adjaye 2005:110, Pearce et al 2006:87, Figure 6.1)

11.1. Valuation methods for non-market valuation

The methods[63] presented here serve to identify monetary values of commodities that are not (yet) traded on the marketplace. The information gained can then be used, for example, to feed CBA or to include natural resources into national accounts (Asafu-Adjaye 2005:203). Pearce points out that in the field of economic valuation of natural resources *Environmental Economics* had two successes. First, representatives of the school of thought emphasized the incompleteness of CBA, which traditionally did not include the environment. Second, they developed methods to include them into the analysis (Pearce 2002:66, Borgström Hansson 2003:101ff.). There are two different groups of methods, revealed preference and stated preference,[64] and combinations of both (Asafu-Adjaye 2005:112, Pearce 2002:66).

1. revealed preference: surrogate or indirect market approach; the value is calculated indirectly, through the expenditures that people take in order to enjoy a commodity or the real estate price
   - travel cost method
   - hedonic pricing
   - cost (or expenditure) method
   - benefit transfer method (Asafu-Adjaye 2005:112f., Pearce 2002:66ff., Kumar 2010)
2. stated benefit methods: use direct inquiries such as surveys. They are more flexible and the TEV can be evaluated; in contrast, revealed preference methods can only unravel the use value.
   - contingent valuation
   - conjoint analysis
   - choice modeling[65] (Asafu-Adjaye 2005:112, Kumar 2010)

Asafu-Adjaye (2005:131f.) suggests combining both methods in order to overcome their shortcomings. There are advantages to combining them, like testing the consistency of both approaches or increasing the statistical accuracy. However, there are shortcomings that remain. Accordingly, Asafu-Adjaye (2005:132) concludes, “There is no single technique that is superior to the others. The choice of a particular technique depends on the particular valuation problem at hand.” Although all methods have shortcomings, Asafu-Adjaye (2005:133) states that they are important for decision making, since they show the value of natural commodities that should be taken into account. The picture gets a bit more holistic, revealing some trade-offs. In order to get the TEV, both approaches, stated and revealed preference, can be employed. In order to get non-

63 Pearce et al. (2006:88, Figure 6.2) present a good figure summarizing several stated and revealed preference methods.
See also Kumar (2010); he gives a good overview and introduction to ecosystem service valuation.
64 Kumar (2010) adds a third approach: direct market valuation.
65 Choice modeling is discussed in Pearce et al. 2006:125ff.

use values, however, only stated preference methods can be used (Pearce et al. 2006:87).

11.1.1. Stated preference methods: Contingent valuation

"[Neoclassical economists] tend to believe in value neutrality and objectivity and regard their arguments as 'scientific'. Rational decisions are connected with the existence of optimal solutions based on calculations in monetary or other unidimensional terms (as assumption of complete commensurability)" (Munda 1997:217). Therefore the concept of contingent valuation allows researchers to base reification of natural commodities on the bids of economic agents. Contingent valuation is a kind of opinion poll, where people are asked how much they are willing to pay for something that is not traded (Heinzelring / Ackerman 2002:5). Value in economics is derived from utility or satisfaction. The price that one is willing to pay is a measure for the utility and thus the benefits derived (Asafu-Adjaye 2005:142f.).

Contingent valuation dates back to 1947 but was commonly used only about ten years later (Pearce 2002:67). Pearce et al. (2006:106f.) point out that especially since the 1990s contingent valuation has been used more commonly. One factor pushing the method was probably the Exxon Valdez oil spill in Alaska at the end of the 1980s, where contingent valuation was subsequently used in the lawsuit.

Through interviews, a hypothetical market is created for the commodity in question (Pearce et al. 2006:106). The questions ask for people's willingness to pay (WTP) for a certain commodity or their willingness to accept (WTA) a certain amount of compensation for the destruction of a certain commodity. Theoretically WTA and WTP surveys should have the same result, which is not the case. The WTA is greater than the WTP (Asafu-Adjaye 2005:113, Pearce 2002:67, Pearce et al. 2006:46, 157ff.). Stavins (2007:3) indicates that there are certain parameters according to which one should decide which of the two methods to take. He also points out that there are considerable differences in the result regarding the method used. This is partly due to psychological reasons (Stavins 2007:3, see also Venkatachalam 2007:553). An overview of how the contingent valuation is conducted and which methods are available to get people's bids is illustrated in Asafu-Adjaye (2005: 113ff., Pearce et al. 2006:105ff.).

One advantage of contingent valuation is that other factors can also be included into the analysis. For example the age, the educational level, other socio-economic factors or the reason for the stated bid can be considered (Asafu-Adjaye 2005:115, Peace 2002:67). This gives a much richer picture of consumer choice than revealed preference methods. Through integrating the income of the respondent, for example, the intensity of preference – what share of income would be devoted

to protection – can be illustrated (Asafu-Adjaye 2005:144). Or asking for the motivation of respondents making a certain bid can disclose some kind of intrinsic value. Pearce et al. (2006:87f.) argue even if the intrinsic value cannot be determined through consumer preferences, since intrinsic values are external to this preference, the notion of intrinsic values can still be captured.

Another advantage of stated preference methods is that one can gain use and non-use values. Accordingly, it is possible to identify option values or existence values. This is possible since the value of the commodity is not derived through direct or indirect consumption, but rather through hypothetical markets (Pearce 2002:67). A third advantage is that contingent valuation methods are straightforward and do not need theoretical assumptions, like revealed preference models. The assumption is, however, that the asked person is able to truly state his opinion on the value (Asafu-Adjaye 2005:117).

Asafu-Adjaye (2005:118ff., see also Pearce et al. 2006:119ff.) presents seven problems that are related to the method: a) hypothetical bias, b) embedding effect, c) bid vehicle bias, d) starting point bias, e) information bias, f) part-whole bias, g) non-response bias. The hypothetical bias indicates the potential for distortions due to the mere hypothetical character of contingent valuation. People do not really have to pay, so they might overstate their WTP. Free riding is another factor that can influence the WTP, when people understate their WTP, thinking that the others should pay more. On the other hand, people might overstate their WTA. Asafu-Adjaye (2005:118), however, states that studies comparing the indicated and the actual WTP could not find a significant difference. Embedding effect refers, for example, to distortions happening due to possible substitution of the environmental commodity in question. People might understate their WTP if they know that the respective commodity is substitutable. A strategic bias implies people over- or understating their bid in order to influence the outcome. The bid vehicle bias corresponds to the payment transfer means that will be employed. People may not like a certain vehicle – e.g., taxes, – and thus understate their WTP. Another bias refers to the bid method applied: the starting point bias. Inquiry formats start with a certain bid; this might already bias the outcome. Also the information given can influence the result, leading to an information bias. The part-whole bias describes people's similar response when first asked to value a whole ecosystem and then only a part of it. And last but not least the non-response bias, which indicates the general problem of surveys, that only certain people are willing to participate. Consequently the result is biased, not being based on a representative sample (Asafu-Adjaye 2005:119f., Gowdy / Mayumi 2001:226).

Especially hypothetical, part-whole strategic, vehicle, starting point and non-response biases are

relevant for contingent valuation and less so to other stated preference methods like conjoint analysis or choice modeling (Asafu-Adjaye 2005:121). Asafu-Adjaye (2005:116f., see also Pearce 2002:67) explains these two stated preference methods. Since contingent valuation is the most used method I will not expand on the other two.

A completely different problem is illustrated by Gowdy and Mayumi (2001). They highlight the issue of contingent value methods (CVM) from its theoretical underpinnings, stating that the theory of consumer choice itself is outdated. The theory explaining how consumers decide, applied by *Environmental Economics,* does not correspond to more recent scientific findings. Regarding CVM, several problems arise. “The problem is not that CVM responses are not real, but rather that humans may not act according to the axioms of consumer choice theory. Because they are based on axioms developed for mathematical tractability, not realism, market valuation methods do not conform to observed behavior” (Gowdy / Mayumi 2001:226). Assumed invariance of preference does not, for example, hold in reality, thus the preferences of consumers vary over time and depend on circumstances. Indifference is also not prevalent in reality. Instead consumers would rather use lexicographic ordering,[66] which results in consumers not being able or willing to make trade-offs between different options (Gowdy / Mayumi 2001:228f., Van den Bergh 2000:52ff.). Gowdy and Olsen (1994:163, see also O'Neil / Spash 2000) emphasize that if indifference does not apply, then contingent valuation is deprived of its base. Even more fundamental, the assumed rationality of the *homo oeconomicus* is doubtful. (Gowdy / Mayumi 2001:234)

11.1.2. Revealed preference models

Travel cost method, hedonic pricing, market value / cost methods, averting or defensive behavior, cost of illness and benefit transfer method are among the revealed preference methods (Asafu-Adjaye 2005:121, Pearce 2002:66ff., Pearce et al. 2006:92ff.). Stated preference means that interviewees state their preference; revealed preference, in contrast, prefigures that the value is revealed through another medium. Market prices are used to reveal the value that people may attach to certain commodities that are actually not traded on the market. Thus it is consumer's behavior and purchases that provide information about non-market values. This is, for example, the costs people are willing to bear in order to visit a certain place, or the rent that people are willing to pay to live in a clean region, or the cost people have to bear for medical treatments due to illnesses caused by bad air quality (Pearce et al. 2006:92). Pearce et al. (2009:93) indicate that getting the value information through real consumer behavior, rather than through hypothetical questions, is this method's advantage. It was mentioned above that stated preference methods have several disadvantages due to the format of this method resulting in people over- or

66 Hierarchical ordering.

understating their bids. The disadvantage of revealed preference methods is, however, that it is not easy to deduce a commodity's value from a price paid. Moreover, people's intentions of buying a certain product are not revealed. Stated preference methods, in contrast allow, getting this information. Another disadvantage of these methods is that one can only investigate use values.

Travel cost method

According to Pearce (2202:66f.) the travel cost method was first conducted in 1947 by Hotelling but became a commonly used method only ten years later. The method is based on the assumptions that a) cost that people bear to visit a place reflects a person's value of that place and b) that people react to increasing costs of traveling or entry fees (Asafu-Adjaye 2005:121, Pearce et al. 2006:96).

The limitations are found in the underlying assumptions that the costs are related to the valuation of a site. Little travel costs are interpreted as low valuation, which may not be true (Asafu-Adjaye 2005:123ff.). Moreover, one can only value the particular site, and hence the valuations cannot be expanded on other commodities or non-use values. Additionally only people who travel there are included; others that probably also value the site but cannot go there are excluded. Apart from this there are conceptual problems concerning multiple destinations and seasonal fluctuations can bias the result of the survey. Some researchers want to include opportunity costs such as time, but it is not clear how to do this (Asafu-Adjaye 2005:124f. Pearce 2002:67, Pearce et al. 2006:96ff.).

Hedonic pricing

Hedonic pricing is a method that derives the value from the market prices. This could be the real estate rents or prices that vary due to environmental conditions, like noise disturbance, traffic, park areas, etc. The price for an object therefore reflects an individual's WTP for certain attributes (Asafu-Adjaye 2005:125f., Pearce 2002:67f., Pearce et al. 2006:93f.). This approach has, like others, some limitations, like multicollineraity,[67] and that the rents depend also on external factors, like taxes, that are not reflected in the analysis. Moreover, people's decisions may not reflect the quality of environmental commodity. People may rent a flat because it is close to work, rather than because a park is nearby. Mere observations of the rental prices do not disclose this information (Asafu-Adjaye 2005:127f., Pearce et al. 2006:94).

Market value method

This method uses market prices for environmental commodities. This is only possible for

67 The factors influencing the result are highly correlated, for example, a road near the apartment causing air and noise pollution. No one can say which influence causes what price decline (Pearce et al. 2006:94).

commodities that are already traded on an established market and it is also only possible to get the use value. Three sources can be used to get a value (Asafu-Adjaye 2005:128):

1. “Direct use: e.g., timber production, fish harvest, tourism;
2. indirect uses: e.g., the value of water of protected watersheds; and
3. option values: e. g., gene research, forest conservation.”

This method then tries to find a link between changes in the environment and following changes in the prices of the commodity. Asafu-Adjaye (2005:128) lists some advantages and disadvantages of using this method.

Market cost method

The market cost method captures the cost to achieve a certain outcome. This includes restoration as well as prevention activities. The costs for prevention and / or restoration are compared to the costs of replacing the environmental commodity. The method is based on the assumption that the value of the commodity “[...] is equal to some multiple of the cost of producing it” (Asafu-Adjaye 2005:129). There are three different approaches: a) change in cost, b) replacement cost, c) defensive expenditure (Asafu-Adjaye 2005:129f., Pearce et al. 2006:98f.). Again, the limitation of this method is that it only captures part of the total economic value, e.g., non-use values are excluded.

Benefit transfer method

This method also allows obtaining the non-market value. The advantage is that this method allows the transfer of survey results from one venue to another, which saves money and time. Certain conditions need to be met in order to make the transfer valid. This is that the conditions need to be similar, the population should be similar, and the first study should not have been undertaken long time ago (Asafu-Adjaye 2005:130, Pearce et al. 2006:87, Pearce et al. 2006:254ff.). Quillérou and Thomas (2012:10) conclude that harmonizing the methods employed would make the transfer of results much easier and would thus allow to spare much time and resources.

12. Environmental Cost-Benefit Analysis

Cost-Benefit Analysis[68] (CBA) is a tool to compare different investment options, and thus is an information tool for decision making (Asafu-Adjaye 2005:185). Pearce et al. (2006:31) point out that not including environmental commodities results in neglecting them in economic decision

68 The history of CBA is outlined in Pearce et al. (2006:29ff.); the steps of CBA are illustrated in Asafu-Adjaye (2005:146), Pearce (2006:52ff) and Pearce et al. (2006:51ff.).

making. Again the problem of externalities applies (Pearce et al. 2006:31). Externalities borne by third parties were not included in orthodox CBA. Thus we have again the difference between private and social benefits and costs. One can distinguish between social and private CBA. The former is used to analyze the social compatibility of investment options; accordingly, the net social benefit should be positive. This is calculated subtracting the opportunity cost from the WTP. If net social benefit is positive, following the CBA logic, the losers can be compensated. If this is theoretically possible we have potential Pareto improvement.[69] However, actual compensation does not need to take place (Asafu-Adjaye 2005:145, Pearce et al. 2006:32). The difference between social and private CBA explains why the desirability of an investment option can differ for the two parties (Asafu-Adjaye 2005:146).

Environmental Economics' contribution to CBA is that through including natural resources the analysis became more holistic. Not only market values are included, but also non-market values and thus the notion of irreversibility is considered; hence, potential costs of the damage or destruction of environmental commodities are included. Use values express the direct benefits and costs, while non-use values are passive ones which often describe the ecological impact of an option (Stavins 2007:3). One can even include the quasi-option value that is gained if an option that has potentially irreversible harmful effects is not undertaken. Postponing the implementation of an option might unravel more information and therefore might allow the protection of the respective endangered natural commodity (Pearce 2002:71f., Fisher 2000, Pearce et al. 2006:146ff., Van den Bergh 2000:57). This has the notion of the precautionary principle, assigning "[...] a value to caution in a world of irreversibility and uncertainty" (Pearce 2002:72).

Generally one has to point out that uncertainty is a major issue for environmental planning and therefore also for CBA. As Pindyck (2007) points out, the time-spans of investment projects that affect the environment are intergenerational. The assumptions taken in order to analyze costs and benefits are thus uncertain. Costs and benefits of a certain action 50, 100 or 200 years from now are hard to calculate. This is particularly the case since environmental dynamics do not follow a linear pattern and effects can be irreversible. It is unknown, and probably will always be, when thresholds are reached that result in an ecosystem's collapse and the point of no return is reached. All this further complicates the choice of the "right" discount rate.[70] Concerning CBA, irreversibility and the costs and benefits that are related can be applied to the environmental but also to the economic part. A society might have to bear certain costs if, e.g., a particular ecosystem was destroyed forever and they would enjoy the benefits if it was protected. On the other hand, there

69 Compare *Kaldor-Hicks* compensation.

70 Pearce et al. (2006:186f.) refer to hyperbolic discount rates which include the notion of uncertainty into CBA.

are also certain forgone economic benefits if it was protected; forgone economic benefits that are lost forever. Hence there are also irreversible economic costs and benefits. There are uncertainties about the costs and benefits, and actions undertaken will have in either way irreversible effects. What assumptions are made for CBA immensely influence the result and hence the investment option that will be implemented. However, due to the uncertainties, CBA will never deliver reliable future projections.

The CBA concept is based on the idea of relatively scarce resources. Hence if a scarce resource is used for one project, it is probably not available for other usages anymore (Asafu-Adjaye 2005:145). Thus a decision has to be made which option to take. The costs and benefits of each option are compared with a business as usual option. The values of costs and benefits are captured in opportunity costs, which are the forgone gains and losses that would have been materialized choosing one of the other alternatives (Asafu-Adjaye 2005:151ff., Stavins 2007:2). For an option to be favorable costs have to be lower than the benefits (Stavins 2007:1f.). CBA is a tool analyzing the economic feasibility of investment options. The economic feasibility is connected to the potential Pareto improvement, hence whether gains are bigger than losses and whether theoretically gainers could compensate losers. If this criterion is fulfilled an investment option is not only economically reasonable but also feasible (Wiesmeth 2012:156f., Asafu-Adjaye 2005:145).

If we only consider marketed goods traded at a perfect market, the opportunity cost would be reflected through the price (Asafu-Adjaye 2005:145). “However, in practice, markets are distorted for some goods or, in the case of environmental goods, are non-existent. In such cases, we have to use alternative means of estimating the opportunity cost” (Asafu-Adjaye 2005:145). These means are stated and revealed preference methods explained above (Stavins 2007:3).

As was already pointed out not all environmental commodities have a monetary value, since they are not traded on the market. In order to include them in a CBA these values have to be identified through the methods presented above. Quillérou and Thomas (2012) present an overview on the methods used to identify monetary values for the various ecosystem services and their use and non-use value. They present two different approaches to identify the TEV, either to calculate the aggregate with contingent valuation, or to calculate single services through different methods. “The net sum of all the relevant WTPs and WTAs for a project outcome or policy change defines the TEV of any change in well-being due to a project or policy” (Pearce et al. 2006:86).

Hypothetical market prices, which are derived from revealed or stated preference methods, and real market prices are assumed to be value judgments indicating individuals’ preferences. CBA is

based on this assumption and accordingly decisions are made following the aggregated individual preferences (Pearce et al. 2006:32, 42, Asafu-Adjaye 2005:151). Confronting costs with benefits CBA is a tool that promotes rational decision making (Pearce et al. 2006:34.) If CBA is only undertaken *ex post* it is a means to test whether the decision reflected the aggregated individual preferences. (Pearce et al. 2006:55)

12.1. Discounting

The investment options are analyzed over the whole lifespan[71] of the activity (Asafu-Adjaye 2005:160). Future costs and benefits are integrated in the analysis as net present value, which (adjusted[72] for assumed increases in technological innovation) reflects people's preference for receiving benefits rather now than later (Pearce et al. 2006:59). This method is called discounting and is used in order to allow the evaluation of different options according to their economic performance at one point in time (Asafu-Adjaye 2005:158, Pindyck 2007:45, Pearce et al. 2006:42). A discounted cash flow is the reduced future stream to the net present value (Asafu-Adjaye 2005:158). “The discount rate in social CBA reflects society's preferences between present and future consumption. In general, a high discount rate implies that the society has a relatively stronger preference for present consumption over future consumption, while a low discount rate implies a relatively stronger preference for the present” (Asafu-Adjaye 2005:159). Borgström-Hansson (2003:88) states that discounting is applied due to the belief that future people will be richer than the presently living people. This belief is based on the historic observation of people growing ever richer. Additionally it is assumed that it is rational to care more about the current generation than about future ones. Asafu-Adjaye (2005:159) and Pearce (2002:71f.) point to the controversiality of discount rates and that some economists are completely and particularly against high discount rates, since they are seen as a cause of environmental degradation. This is because high discount rates prefer short term profits, so they generally oppose sustainability goals (Asafu-Adjaye 2005:159, Pearce 2002:71, Pearce et al. 2006:184).

Pearce et al. (2006:184f.) point out that there is no way to avoid discounting. Not to discount means to use a zero discount rate, which is still discounting. A zero discount rate implies that people care about others living 50, 100, 200 or thousands of years from now. If this is not the case then a discount rate above 1 should be used. A low or zero discount rate also means to sacrifice present consumption for future generations. If every generation applies this thinking, no generation will profit from such a behavior. The result is a sustained impoverishment of society.

71 External effects of an investment option can, however, exceed its economic life, affecting generations not included in the calculations (Stavins 2007:2).

72 Also inflation should be netted out. This is the preliminary step before discounting (Pearce et al. 2006:44, 59, Asafu-Adjaye 2005:152).

Choosing the “right” discount rate is difficult due to the subjectivity of consumers in choosing a suitable discount rate (Stavins 2007:2). Pearce et al. (2006:186ff.) explain that for CBA constant discount rates or hyperbolic discount rates can be chosen. The latter means that the discount rate decreases with time. This kind of rate seems to be more realistic according to research.

Asafu-Adjaye (2005:159) states that it is still a very controversial issue which discount rate to take. One can, e.g., take long term interest rates on government bonds. (He states that US and Australia choose rates from 10 to 8%.) It is, according to Pearce (2002:71), again *Environmental Economics'* contribution to CBA that much progress in the discounting debate happened, although the issue is not solved. However, including non-market values and adjusting discounting aligns CBA with sustainability goals. (Pearce 2002:72)

Concluding, one can say that “[t]he soundness of empirical benefit-cost analysis rests upon the availability of reliable estimates of social benefits and costs, including estimates of social discount rate” (Stavins 2007:2).

12.2. Critique concerning Environmental Economics' methods

Rees (2001:5f.) points out that as the neoliberal system does not reflect human nature relations, the model was not able to foresee the environmental problems, nor is it able to explain this development. The only thing that the current economic system offers is – following its world view – treating the problem as market failure. Hence this failure needs to be corrected in order to solve the problem. This should be done through internalization and the right price signals. However, Rees (2001:6) states that such measures are dangerous because they are based on wrong assumptions about the real world. Haberl et al. (2004:200) point out that environmental valuation, “[...] however useful they may be to demonstrate the economic value of these assets, is insufficient to capture the full significance of natural capital for life support.” Wackernagel et al. (1999:367f.) also point out that nature is the basis for human existence and is not an asset that can be substituted as is implied by monetary valuation. Even though monetary valuation can help raise people's awareness, “[...] it is not suitable for pointing to action, identifying ecological limits, or describing competing uses of nature” (Wackernagel et al. 1999:377). Similarly, Costanza et al. (1997), who did one of the first estimates of world's ecosystem services, point out that natural capital is essential for human survival, since it is the base for all other forms of capital humans depend on. Following this, they conclude:

> […] it is not very meaningful to ask the total value of natural capital to human welfare, nor to ask the value of massive, particular forms of natural capital. It is trivial to ask what is the value of the atmosphere to humankind, or what is the value of rocks and soil infrastructure as support systems. Their value is infinite

in total. (Costanza et al. 1997:255)

Costanza et al. (1997) estimated that global ecosystem services have an annual value of US$16-45 trillion, while the average of US$33 trillion per year was greater than the annual GDP. This shows that ecosystem services have an extremely high value, probably a higher value than can be paid for. From an economics perspective one can say that a value greater than GDP does not make sense. Costanza et al. (2011:3) encountered this objection in stating that GDP does not reflect all costs and benefits and thus GDP might be greater or smaller anyway.

Ecological economists are not entirely against market internalization and methods developed by orthodox or *Environmental Economics*. Daly (1996:14), for example, is not against internalization and interprets it as a possibility to share environmental costs and benefits. He also advocates the PPP, as well as taxes or assurance bonds, in order to spread the costs of environmental destruction and make the private sector bear their self-inflicted damages (Daly 1996.16, Costanza et al. 2013:137f.). Costanza et al. (1997) also employ monetary valuation, although they acknowledge the limitations of this method. They reason this decision by stating that it is meaningful to investigate welfare losses that follow changes in ecosystem service supply. Anyway, Daly (1996:45) argues that internalization is not the solution to environmental problems. He argues that the frequency with which the concept is applied to natural resources shows that there is a fundamental problem within the economic system.

Müller (2001:425f.) expands on the problems related to environmental valuation and internalization. One big issue is the information gap referring to the problem that in order to set, for example, the proper tax level governments have to know “[...] the economic activity of individual pollution, their emissions, the ambient pollution concentration, exposure to pollution by individuals, physical damage functions, and, ultimately the monetary value of environmental damages” (Müller 2001:425). This is information which governments usually do not have and which is difficult to acquire, due to strategic considerations of economic agents. The same is true for market-based instruments. Müller (2001:427) indicates that during the negotiation process both sides are characterized by their limits of their cognitive abilities. Moreover, both sides have a rational reason for over- or understating the environmental pollution: maximizing one's personal utility.

Similarly, Mauerhofer et al. (2013), examining PPP and PES, point out the disadvantages, connected to insufficient knowledge, the lack of legal regulations, their insufficiency and or weak implementation. Furthermore, they point out that these methods merely care about the efficiency of each project, rather than about the overall sustainability goal, including considerations of social

fairness.

Venkatachalam (2007:553) points out, “As far as the ecological economics is concerned, it seems that there is no consensus not only on the valuation techniques to be used for estimating the economic values but also on the economic value as such.” He indicates that some ecological economists completely reject monetary valuation of nature, since the valuation is based on institutional settings that influence humans' perceptions and thus valuation. On the other hand *Environmental Economics* is fully aware of the influencing power of insinuations accompanying some contingent valuation methods and thus developed mechanisms within valuation methods that balance these influences. Other ecological economists try to hook up on monetary valuation and estimate the intrinsic value in order to illustrate that it is much higher than the mere use-value. In doing so *Ecological Economics* also relies on monetary valuation (Venkatachalam 2007:553, see e.g. Costanza et al. 1997, Costanza et al. 2011).

Gómez-Baggethun and Ruiz-Pérez (2011) have a different approach in differentiating between economic framing, monetization, appropriation and commercialization of environmental commodities. They argue that the mere economic framing, which is the identification of an ecosystem service that has an effect on human wellbeing alone, is already sufficient to illustrate the value of this service. In case people do not understand the value of an ecosystem service through the mere figure of its contribution to human wellbeing, the second step can be undertaken. Putting a monetary value on a natural commodity is not the problem, but rather the subsequent appropriation and commodification. Apart from ethical or methodological problems regarding commodification (as well as appropriation), commodification also somehow downgrades the “real” value of environmental commodities. Nearly total substitution or the commensurability of values of normal market commodities is expanded to natural commodities, which in reality does not apply (see also Kosoy / Corbera 2010). Gómez-Baggethun and Ruiz-Pérez (2011) admit that in the current system monetization always leads to commodification.

CBA is often criticized, since it exhibits some weak points. One is, for example, that it is not too easy to sort out all the costs and benefits borne by a certain action. This regards questions of geographic dispersion and the timeframe (Ibrahim et al. 2012:16f., Borgström-Hansson 2003:115f.). Regarding the geographic dispersion not only the question of where costs and benefits occur but also of who benefits and who bears the costs arises. CBA does not explicitly care about this question (Heinzelring / Ackerman 2002:23f.) and as already explained, potential Pareto efficiency does not need compensation to actually take place. Concerning the timeframe, usually discounting is employed. The discount rate allows the evaluation of future impacts in

present values. It can be difficult to choose the right discount rate, since effects can be spread over the whole period, involving more than just one generation. Heinzelring and Ackerman (2002:6ff.), for example, illustrate that at a discount rate of 3% after one year $100 is only worth $97 and after 20 years only $55. Accordingly, discounting leads to a biased valuation with time passing by. Especially regarding environmental investments, costs accrue now, while benefits materialize only much later. Therefore applying CBA for long-term projects, costs are likely to outweigh benefits. As Heinzelring and Ackerman (2002:11) accurately state, " […] cost-benefit analysis involves the creation of artificial markets for things – like good health, long life, and clean air – that are not bought and sold. It also involves the devaluation of future events through discounting." They go on arguing that "[CBA] systematically downgrades the importance of the future in two ways: through the technique of discounting, and through predictive methodologies that take inadequate account of the possibility of catastrophic and irreversible events" (Heinzelring / Ackerman 2002:21). They explain that for economists it is cheaper, due to discounting, to have a problem later than sooner, because the value assigned to the problem shrinks over time. This is the justification to impose problems on future generations.

While some argue that discounting should not be used at all, others are focused on choosing the right discount rate. This difficulty is due to the subjectivity of consumers in choosing a suitable discount rate (Stavins 2007:2). Apart from the discount rate, general ethical questions are connected with CBA. Discounting alone already is a highly ethical issue, since a high discount rate favors the present over the future (Martinez-Alier 1987:158, Borgström-Hansson 2003:125). Martinez-Alier (1987:158f.) points out that even if we do not use discount rates (hence zero discounting) certain distributive considerations need to be taken into account. Concerning non-renewable resources, it still means giving the same importance to present generations as to future ones. Since we do not know how much resources will be needed or demanded or what technologies and what supply will influence the market, we still probably deprive future generations of the right to profit from the present resources in the same way as present generations do. Hence, concerning non-renewable resources, the allocative function of the market does not work. So far economic growth is positively correlated with resource throughput (substantial absolute decoupling so far could not be achieved). Economic growth is believed to provide a more prosperous future, but depriving future generations of resources that they will also need to satisfy their needs and their economic growth inevitably inhibits a more prosperous future (Martinez-Alier 1987:159). The only thing that this fact seems to conceal is the promise of improved technologies that will solve all the problems.

"Questions on optimality of inter-generational allocation of exhaustible resources cannot be

separated from questions on moral values, against the basic rules of conventional economic theory" (Martinez-Alier 1987:160). Martinez-Alier argues that even the intra-generational allocation does not imply fairness, but at least presently living people have the possibility to improve their situation through participation in the market. People that are not alive now, do not even have this chance.

Pearce et al. (2006:34) point out that until today no solution to the problem of which discount rate to choose has been found.

However, apart from discounting, calculating a price for environmental commodities is also a very delicate topic. "What is quite unique to cost-benefit analysis, and far more problematic, is the other side of the balance, the monetary valuation of the benefits of life, health, and nature itself" (Heinzelring / Ackerman 2002:5). This reveals, for example, the whole debate regarding the value of a statistical life. Can one put a price tag on life? If so, how should CBA be used to draw policy measures from it? The same problems arise from valuing nature. Is it possible to put a price tag on a certain species or an area? If the value is lower than the benefit of a certain economic undertaking, should it then be sacrificed (Heinzelring / Ackerman 2002:6ff.)?

Salles (2011), for example, discusses the delicate topic of ecosystem valuation, pointing to the issues already touched upon, like open access goods or basing valuation on utility and the anthropocentric stance of valuation. He also emphasizes a problem already pointed out by Wiesmeth (2012) and discussed in this thesis: the issue of awareness. This refers to the fact that as long as valuation is based on people's subjective perception, decisions might be based on wrong valuations. Costanza et al. (2011:3) also emphasize that issue. They offer a suitable analogy: "If a tree falls in the forest and there is no one around to hear it, does it still make a sound?" They point out that the answer to that question depends on determining whether a sound is only a sound if it is heard by someone. If there is no one to hear it, probably no one bothers, but still a falling tree causes physically measurable effects. Concluding, they state that if one takes the former understanding of sound, revealed and stated preference methods would be sufficient; in the latter case they would not. This analogy indicates the problem of limited human perception and second, it is a call for also using other indicators.

Moreover most utility approaches use ordinal numbers, which means that there is no absolute value (cardinal numbers), but rather relative values. Hence valuation checks possibilities for compensation, for substitution. It is obvious that for many natural goods no adequate substitution exists. Apart from this humans' imperfect knowledge about the interconnectedness and

dependencies within and among the ecosystems might again lead to misconceptions concerning the substitutability of natural goods. The author points out that that the fact that human knowledge regarding the importance of or connection to certain environmental commodities influences the valuation. Apart from a certain knowledge gap concerning environmental commodities, we often face the problem that one cannot draw a demarcation line, determining where the commodity *begins* and where it *ends*. Moreover, the ordering of priorities might be lexicographic rather than merely utilitarian (Salles 2011:477). O'Neil and Spash (2000:6), for example, explain that especially environmental valuation underlies lexicographic ordering. Issues like this challenge the applicability of CBA to environmental commodities (Salles 2011).

Concerning utility or preferences, O'Neil and Spash (2000:5) point out that the market system is blind to the reason for preferences.

> Preferences for environmental goods that are grounded in aesthetic, scientific and communitarian judgements cannot be treated as on par with preferences for this or that private commodity. Judgements about environmental goods are not expressions of mere taste that can be priced and weighted one with the other. They are judgements that are open to change through public deliberation, mediation and debate. It aims to realise through means of a surrogate for markets what, within neo-classical theory, the ideal market is supposed to do – aggregate efficiency given preferences […]" (O'Neil / Spash 2000:5).

Indeed this is a general critique, rather than an exclusive one on environmental valuation. It indicates the general problem of valuation already outlined above (see value and incommensurability). This quote illustrates the fact that markets do not regulate everything through a magic hand. People's preferences are made through social interaction. It is not innate in human beings from birth on, what they desire, what their preferences are – let us exclude very basic needs like water and basic nutrition. Preferences are culturally coined, bound to ethical rules within the particular society / group and change throughout life. It is nothing stable. Even if one unravels the background for valuation one can still discuss if all the reasons are equally legitimate. Is the mere aspiration for utility gains equally important as, e.g., culturally or religiously inspired valuation that appreciates mere existence without any self-interest? Additionally, it was already pointed out that people hold different roles (e.g., consumer and citizen, parent, sister...) and that according to the role WTP changes. Within CBA these differences are neglected and humans are generally only seen as selfish individuals. In doing so Heinzelring and Ackerman (2002:14) argue that CBA "[...] distorts the question it sets out to answer: how much do we, *as a society,* value health and the environment?"

O'Neil and Spash (2000:5) argue that CBA often does not allow public deliberations which make the fundaments for value decisions explicit and thus transparent. Additionally to the fact that there are different sources for valuation, these different sources may result in a situation where people

are unable to put monetary value on the environment or parts of it. They are simply invaluable and precious (O'Neil / Spash 2000:10, Heinzelring / Ackerman 2002). Heinzelring and Ackerman (2002:15) conclude that "[...] the economic valuation called for by cost-benefit analysis is fundamentally flawed because it demands an enormous volume of consistently updated information, which is beyond the practical capacity of our society to generate." They state that the attempt to assign a price to nature always entails one big problem, which is finding a price for nature. The problem is rooted in the fact that it has no price, because it is not for sale.

Salles (2011:474) even states that monetary valuation probably led to the secession of *Ecological Economics* from *Environmental Economics*. The different perceptions concerning the applicability of CBA to natural commodities also reflect the differences in strong and weak sustainability, which separate both schools of thought.

"Indeed, if no substitution is possible, the very principle of economic valuation fails and the meaning of any valuation no longer holds, except on the basis of the subjective judgments of the subjects involved" (Salles 2011:474, see also O'Neil / Spash 2000:11). In the following section I will discuss another tool that helps in the decision making process. The tool explicitly deals with the feature of incommensurability and uses more than just one unit for comparison. Moreover, it allows public deliberation[73] processes, which are, as just mentioned, not part of CBA.

13. Alternative method to Cost-Benefit Analysis

Although CBA is a highly acknowledged method for the above-mentioned reasons some researchers and stakeholders demand a different kind of method. A first step is to involve stakeholders, hence participatory approaches are needed. Due to the uncertainties and the ethical implications of valuation we are in the realm of post-normal science where orthodox scientific methods do not suffice. The perception of the public is included in order to reach a more democratic and transparent result, where all opinions are heard and considered and where the aim is to reach an outcome with which everyone can live. Indeed, this is not an easy task and the participatory process has to be sensitive to power relations and should not be abused by decision makers (De Marchi / Ravetz 2001).

There are many different participatory approaches that can be employed (De Marchi / Ravetz 2001:7ff., O'Connor 2007).

73 O'Neil and Spash (2000:13) present a table comparing contingent valuation and citizens' jury, giving an overview of how these methods differ.

> The main strength of participatory approaches consists in their scope for creativity. That is, they not only facilitate finding and evaluating alternative solutions, but also framing and re-framing problems in different ways. Thus deliberative participation allows new and broader perspectives and insights to develop. In this sense, participatory approaches go beyond conflict resolution procedures, where only those with a precise and definite vested interest take part. Rather they become a way of enhancing deliberative democracy and favouring social debate on issues of common concern, which are recognised as complex and therefore not amenable to technical fixes or one- shot solutions. (De Marchi / Ravetz 2001:11)

An alternative to CBA is Multi-Criteria Assessment (MCA). MCA is a decision making tool and counts as the same category as CBA or cost-effectiveness analysis[74] (CEA) (Pearce et al. 2006:35, Venkatachalam 2007:553). In contrast to CBA, MCA[75] allows the comparison of different indicators of the investment options using different units and not just a single one (Martinez-Alier 1987:216f., Asafu-Adjaye 2005:204, Gómez-Baggethun / Ruiz-Pérez 2010:113ff., see Figure 16). Hence it is not necessary to translate, for example, the amenity value of a site in monetary terms. Thus MCA is a more pragmatic approach than CBA when monetary valuation is not possible or at least highly contested (Asafu-Adjaye 2005:204).

However, MCA is a method not engaging stakeholders, although the decision maker may ask for their opinion. Therefore an amendment to MCA was developed, Social Multi-Criteria Evaluation (SMCE). Again this method allows the combination of all sorts of indicator units. For example a forest is not only captured by its economic value from wood extraction, but also by its biophysical components or its amenity value. Hence one can include the amount of wood, the biodiversity (e.g., what kind of plants grow), services that are provided by the forest, like CO_2 sequestration or water purification. Also very subjective values can be added concerning the cultural value of the forest. Unlike CBA, SMCE compares different options and checks how the values of the indicators change. SMCE thus unravels that probably one option increases the economic output but negatively affects the other indicators. Additionally one can analyze the likeliness of one option to be implemented through considering stakeholders' point of view and their power within the decision making process.[76]

Indeed one might question whether normal citizens are able to comprehend the complex problems and tradeoffs that have to be made when coming to a decision. Eden (1996:187) states that scientists are the ones identifying environmental problems, “[...] because environmental threats are increasingly only evident through science’s sensory organs, rather than through people’s everyday senses.” However, I argue that exactly due to this reason it is necessary to involve the different

74 See Asafu-Adjaye 2005:185ff.
75 For more information concerning the steps of MCA, see Asafu-Adjaye (2005:206).
76 There is much literature on SMCE: De Marchi et la (2000), Dodgson et al. (2009), Domènech et al. (2013), Gamboa (2006), Gamboa (2008), Garmendia et al. (2010), Munda (2004), Russi (2007), Siciliano (2009).

stakeholders. Decision making processes constitute a possibility to give people insights, to inform them, to raise awareness. It is not wise to hide behind the argument that people are not able to make such decisions, since every day people are confronted with decisions that influence the environment. Promoting an informed society should be of paramount importance. Apart from that, what is acknowledged within transdisciplinary research also applies to environmental decision making. Stakeholders are experts, since they might have knowledge that scientists do not have. So the inputs from society might be crucial to compose a holistic picture of the issue at hand (De Marchi / Ravetz 2001).

Another argument for engaging participatory methods is stated by Costanza et al. (2011:3). They point out that due to the public good character of many environmental commodities, individual preferences become an inappropriate approach to estimate a commodities value. Hence they advocate the adoption of community or group choice processes.

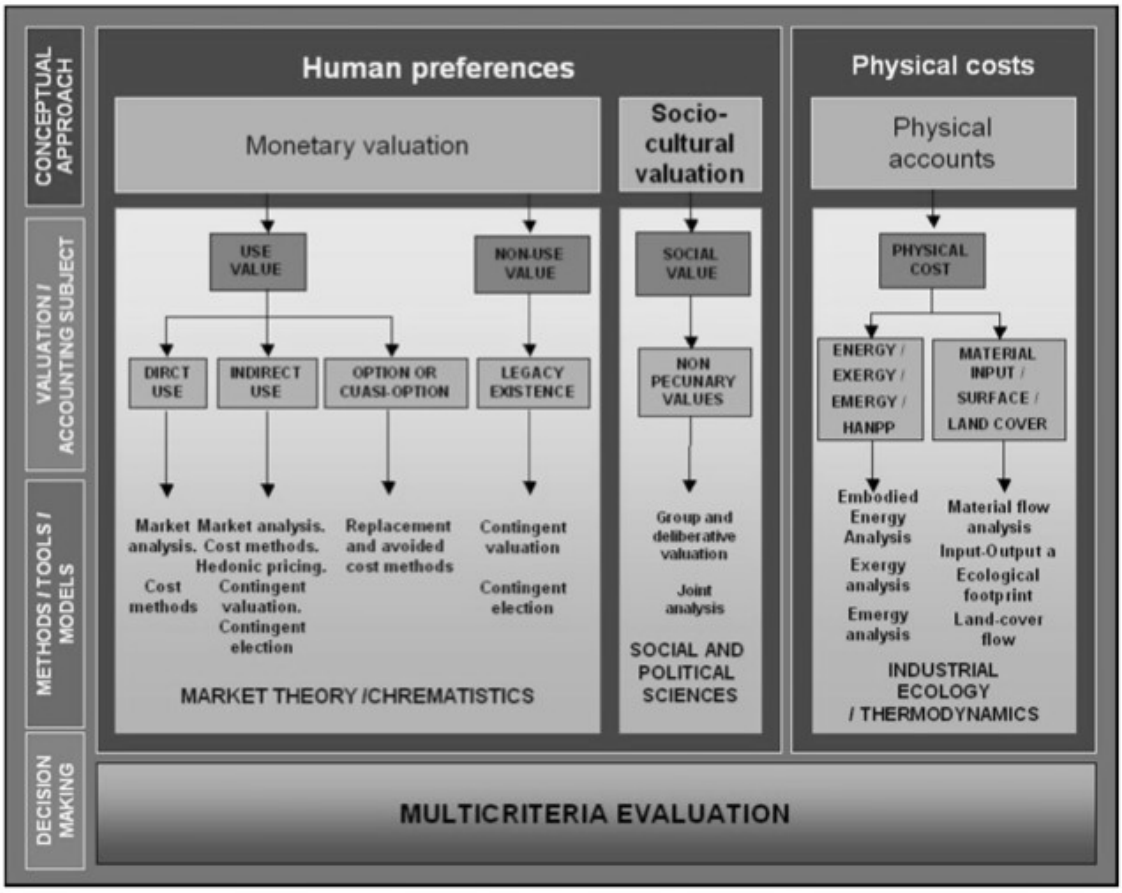


*Figure 16: Multi-criteria assessment (*Gómez-Baggethun / Ruiz-Pérez 2010:113)

As a matter of fact at the end of the day one has to make certain value judgments. A decision maker can, for example, prioritize the economic profit over environmental protection. However, in

contrast to CBA such a decision is more explicit and cannot be camouflaged by mere monetary values. Martinez-Alier et al. (1998:289) state that MCA is not necessarily used for conflict settlement, but as a tool of *Ecological Economics* putting forward a sustainability stance. In that sense first stakeholders and decision makers learn through the process about the tradeoffs between the various indicators and second priorities of decision makers are made explicit (Asafu-Adjaye 2005:203).

Apart from mere preferences of a decision maker, minimum standards can help identify the best option. This means that for example if one option has a very good economic score but does not meet the minimum or maximum requirements of an environmental standard, the option would automatically be eliminated (Asafu-Adjaye 2005:205f.).

I already mentioned Hardin's (1968:1244) approach to incommensurability. The issue of incommensurability is a key argument for using MCA methods. Conducting MCA one can, for example, collect data for different categories like environment, ecological and social. These categories can then either be weighted simply through the different numbers of indicators assigned to a category, or they are weighted according to some kind of assumption. Following Hardin's approach one could weigh according to a survival criterion. Of course this again implies that people or decision makers are aware of the things that secure human survival and indeed not all factors are clear. A weighing system employed can thus illustrate one's attitude. If, for example, economic indicators get a higher score, because they are perceived as being most important and that one can substitute environmental and social losses with economic gains, one can read that this is a weak sustainability approach which is not in line with *Ecological Economics.*

It is a disputable question whether the intrinsic value of nature, for example, is automatically higher than any monetary value. This question cannot be answered through scientific methods but simply through public deliberation considering ethical implications. Putting a price tag on the intrinsic value of nature does not help answer this question. Hence, although *Ecological Economics* is not entirely against environmental valuation it is not seen as the prior means to promote the decision making process. Therefore, *Ecological Economics* rather tries to find other means that better and more holistically illustrate tradeoffs (Martinez-Alier et al.1998:283). "Ecological economics does not resort to a unique type of value expressed in a single numeraire. On the contrary, it goes beyond neoclassical environmental and resource economics by including the physical appraisal of the environmental impacts of the human economy" (Martinez-Alier et al.1998:284).

14. Beyond GDP

The Gross Domestic Product[77] [78] (GDP) is a measure of economic activity and allows observation of the economic performance, comparing one period with another and one country with another (Common / Stagl 2005: 143f., Hoag / Hoag 2006:253, Constanza et al. 2009:3, Boyd 2008:4). The GDP was developed in the 1930s and 1940s, when the world was struggling with the aftermath of the Second World War and the Great Depression. First attempts to calculate GDP were induced by the interest in investigating the financing of the Second World War. After the war economic growth was perceived as the means to promote economic wellbeing (Costanza et al. 2009:5, Boyd 2008:2, Hamilton / Lutz 1996:3). From its invention onward many economists and scientists warned not to misinterpret GDP growth as an indicator for social wellbeing (Stiglitz et al. 2010, Costanza et al. 2014, Costanza et al. 2009:6, Den Butter / Verbruggen 1994:189).

Since the publication of the *World Commission on Environment and Development's* (WCED) report *Our Common Future* in 1987 and other important cornerstone events, most notably the *Rio Earth Summit* in 1992, economists have tried to find and design an extended and amended indicator or index that adjusts the bias of GDP (Pearce 2002:63, Hamilton / Lutz 1996:1, Alfsen et al. 2006:7, Bartelmus 2013:1, N/A 2012:1f.). GDP is often criticized and now it is more or less acknowledged that GDP does leave many spots blind and does not necessarily illustrate what was constructed into it (Van den Bergh 2007:2, Darmstadter 2000:11). “Although economists did not devise GNP to be a direct measure of welfare, nevertheless welfare is assumed to be highly correlated with GNP” (Daly 1996:151, Munda 1997:214, Common / Stagl 2005:145, Costanza et al. 2009:4, Van den Bergh 2007:2, Fasolo et al. 2013:634, Kubiszewski et al. 2013:57). Van de Bergh (2007) emphasizes that despite acknowledged facts illustrating the shortcomings of GDP, it is still widely used as a major economic indicator that strongly affects real economy through the decisions made by governments and the private sector according to GDP data and prognosis (Costanza et al. 2009:7, Boyd 2008:2). Van de Bergh (2007:10f.) explains that GDP follows a self-fulfilling prophecy pattern. Media and economists proliferate the message of the positive influence of a growing GDP on welfare. “GDP can thus be seen as an abstraction invented by humans without direct physical meaning. The GDP concept is active in the domain of perceptions, theories and beliefs. Only in this way does it influence the real economy” (Van de Bergh 2007:10).

Besides the misinterpretation of GDP as being a welfare indicator, GDP has several shortcomings. First, it does not include distribution, thus a high GDP does not say anything about the distribution

77 For the history of GDP see Costanza et al. (2009:5ff., Den Butter / Verbruggen 1994:189).

78 Some authors use the Gross National Product (GNP), rather than the GDP. The former measures the economic activity within a country irrespective of the nationality of the companies’ owners. The latter measures economic activity of nationals irrespective of the location of the enterprise. For this thesis the difference is not decisive and is thus neglected. I mention this in order to omit confusion.

of economic wellbeing among a population. Second, only economic activities that are officially recorded are captured within GDP, hence black market activities, voluntary work or subsistence work are not included. Third, it does not distinguish between “good” and “bad” economic activity. Therefore it does not matter whether GDP increases due to higher military spending, reconstruction activities after a natural disaster, increasing alcohol and tobacco consumption or higher spending for education or preemptive health care (Common / Stagl 2005:147f., Costanza et al. 2009:4ff., Asafu-Adjaye 2005:311, Daly 1996:115, Kubiszewski et al. 2013:57, Boyd 2008:3f., Darmstadter 2000:12). Van den Bergh (2007) presents a list of recognized economists that criticized GDP and thoroughly discusses the points of critique. The methodological and conceptual shortcomings of GDP are one problem; another is that economic performance is not the only factor influencing welfare. Hence if GDP was meant to be a welfare indicator other factors would have to be included as well (Fasolo et al. 2013:634, Stiglitz et al. 2010).

Especially the blind spots of GDP concerning distributional issues are acknowledged, thus distributional policies interfering in the market economy are no taboo anymore in neoliberal economies (Daly 1996, Costanza et al. 2009:10). Moreover, it is acknowledged that a high GDP does not tell much about the social situation in a country. In order to meet this social implication two tools were developed, the Gini coefficient and the Human Development Index (HDI). The HDI is an index developed in 1990, combining economic with social indicators and thus trying to depict a more complete picture (UNDP, Costanza et al. 2009:18, Van de Bergh 2007:15, Fasolo et al. 2013:637). The HDI is categorized as an index which corrects GDP, since it tries to include more factors that are relevant to measure welfare (Costanza et al. 2009:28f.). Apart from shortcomings of this particular index concerning the measurement of the social performance within a nation, HDI leaves blind environmental issues (Van de Bergh 2007:15).

The fact that there are also distortions concerning environmental health is not so widely acknowledged and serious attempts to meet these shortcomings are thus not that old (Daly 1996, Den Butter / Verbruggen 1994:189). As Daly (1996) already pointed out GDP is a measure for throughput, rather than for wellbeing. That throughput needs a biophysical basis is neglected. Therefore for the sake of increasing GDP natural resources – as the basis for all activity – were and are drawn down at unsustainable rates. Hence the wealth of one stock was sacrificed for another one (Costanza et al. 2009:9). The main problem is that GDP does not reflect the relation between economic activity and effects on the environment. Even worse, non-market commodities are eventually attached with a zero value, while measures to protect the environment are counted as abatement costs and are consequentially negative (Munda 1997:214). Costanza et al. (2009) indicate that GDP does not reflect the depreciation of natural capital, so neither the depreciation of

renewable natural capital nor the liquidation of non-renewable natural capital is captured. Accordingly, GDP overstates the welfare state of a nation (Asafu-Adjaye 2005:3010f., El Serafy 1997:218, Darmstadter 2000:13).

Besides all the other shortcomings of GDP, environmental factors not being reflected in GDP is the most relevant issue for this thesis and for the two economic schools of thought examined. This neglect also reflects the denial of the dependence of economy on environment (Common / Stagl 2005:145). Costanza et al. (2009:9, see also Boyd 2008:4) point out that

> [b]y measuring only marketed economic activity (the inner circle), GDP ignores changes in the natural, social, and human components of community capital on which the community relies for continued existence and well-being. As a result, GDP not only fails to measure key aspects of quality of life; in many ways, it encourages activities that are counter to long-term community well-being.

This was long not perceived as being a problem, but now it is increasingly realized that natural resources are limited and thus are a limiting factor to economic growth and social wellbeing (Boyd 2008:4, Veklich / Shlapak 2012:244f., El Serafy 1997:218f.). Any environmental destruction (harvest, mining, clearing, destruction through catastrophes, etc.) that leads to an increase in economic activity results in GDP growth and is thus explicitly wanted. Costanza et al. (2009:9) emphasize that the particularly worrying thing is that the exploitation takes place at a faster pace than environmental reproduction and absorptive capacities. Thus the stock of natural capital is drawn down. This results in resource scarcity that implies that resources that before were abundant and therefore not considered in economic calculations are now getting attached a price.

The intention now is to integrate natural capital stock and flow data directly or indirectly into the national accounts and thus not only to focus on man-made capital (Pearce 2002:64). The problems of neoclassical economy that were discussed so far also apply to accounting. Not only are social commodities that are not traded on the market not included in GDP, also not-traded natural commodities are neglected. Thus internalization of externalities is again the issue (Boyd 2008:1, Pearce 2002:66, Hamilton / Lutz 1996:1). But for national accounts internalization seems to be even more complex. On the one hand environmental depreciation, destruction and pollution need to be subtracted and accumulation added; this makes up the flow of environmental commodities. On the other hand, if we are concerned about sustainability we have to find out the size of stocks and their reproductive capacity. Not only do we face the problem of quantifying the stock or the size of the flows, if we want to get a single number we also have to translate all commodity values in a single unit, usually money. The methodological problems, problems of data availability and reliability and missing comprehensive frameworks lead to a general reluctance to implement national green accounting. The reliability of generated data is questionable; different

implementation approaches result in lack of consistency among nations but also within nations. These factors make up hurdles in seriously engaging in national green accounts, let alone substituting it for an indicator that is widely accepted and relied on (El Serafy 1997).

An increasing number of indicators and indices try to overcome the shortcomings of traditional GDP. There are several ways these approaches are categorized in order to give decision makers guidance to decide which of the indicators to take. One can categorize them regarding their objective, their underlying concepts, on what kind of data they are built, hence whether they are based on GDP, or whether GDP is not used at all, whether other economic indicators are used or not, whether monetary units are mixed with other quantitative or qualitative data, or whether they try to compile a single number translating other units into monetary equivalents. The various new and emerging indicators and indices should not, however, be perceived as substitutes, but as complements (Fasolo et al. 2013, Bleys 2012, Costanza et al. 2009:10ff., Hamilton / Lutz 1996:7, Costanza et al. 2014).

Some approaches are more popular than others, being promoted by international institutions, like the UN or the World Bank. Some have been dismissed because of methodological issues (e.g., Green GDP). Other methods are not so popular since they do not use GDP data. In this section I will introduce several methods and not only those that are applied by *Environmental Economics*. My intention is to give an overview over some indicators. It is hardly possible to separate them into methods used by environmental economists and methods used by ecological economists. The problem is that there is not a clear-cut border between methods that would be used only by environmental economists and *vice versa*. For example, there are two indices developed by prominent representatives of *Ecological Economics* that use GDP. On the other hand, the Ecological Footprint is also used by scientists that promote the growth paradigm. The reason for ecological economists developing and using indices, including GDP, seems to be motivated by the impulse illustrating how economic performance would look if environmental factors were included. This should then show that economic growth at the expense of environmental health is uneconomic and should not be the aim of national economies. Hence ecological economists use an indicator that is well known and accepted in order to bring their message across. The same seems to be true for *Environmental Economics*. The UNEP uses the Ecological Footprint in their GER. Indeed, it is just one indicator out of several others, one of which is GDP, that is employed to communicate their Green Economy concept. As GDP alone does not tell anything about the environmental impact of an economy, another indicator is needed and therefore the Ecological Footprint is engaged. However, generally parties that promote economic growth will use an indicator or index that somehow includes economic performance indicators. Although the

shortcomings of GDP are well-known GDP does still influence the decisions of the private and the public sector. Not using it anymore is simply impossible (Van de Bergh 2007:10).

Since there is no clear discrimination which economic school of thought uses what kind of macroeconomic indicator I will rather present them according to their relation to GDP. Thus I will start with indicators that correct GDP and try to produce a single number. Then indices that present GDP along with other indicators will be discussed. And finally indicators that do not include GDP at all are outlined.

I only discuss some indicators here. There are many more that are discussed elsewhere, like the Well-being Index (WI) (Fasolo et al. 2013:637), Sustainable Society Index (SSI) (Ibid.:638), Sustainable Net Benefit Index (SNBI) (Van de Bergh 2007:12), Living Planet Index (LPI) (Costanza et al. 2009:19f., Alfsen et al. 2006:10), Happy Planet Index (HPI) (Costanza et al. 2009:20f.), Calvert-Henderson Quality of Life Indicators (Costanza et al. 2009:22) or the Millennium Development Goals (MDGs) (Costanza et al. 2014, Costanza et al. 2009:23) Costanza et al. (2014) present a table giving an overview of several indicators. Stiglitz et al. (2010) also discuss some sustainability indicators as well as the shortcomings of GDP and aspects that have to be considered when creating new indicators. More information on sustainability indicators can be found in Bell and Morse (2008)

14.1. Green Accounting

Green accounting describes the idea to include, in one way or the other, environmental factors in the national accounts.

All approaches that try to correct GDP have the same problems in common. This is the question of how to value non-market commodities or subjectivity concerning the categorization of beneficial and harming factors (Costanza et al. 2009:11f., Alfsen et al. 2006:35). Still, the approach is pursued since it is perceived as being better to correct a flawed indicator than using it without corrections (Costanza et al. 2009:12).

The major difference between corrected GDP and satellite accounts is that the latter does not need to translate physical into monetary units. Both approaches have their pros and cons (Den Butter / Verbruggen 1994:205). The greatest drawbacks of corrected GDP are related to the critique of internalization. On the other hand it is argued that for economic analysis physical accounts do not reveal much and make comparison difficult and leave analysis of the data to the user (Smith 2007:597, Pearce 2002:65, Den Butter / Verbruggen 1994: 188, Bartelmus 2013:2).

Many different approaches to include environmental issues into accounting exist. Veklich and Shlapak (2012:247) point out that no matter whether there exists a consistent methodology or not, the important step is to consider environmental issues in national accounts. Neglecting the negative effects of economic activity, not observing and analyzing them, results in irreversible environmental degradation, which in turn negatively affects the economy and human wellbeing. It seems to be this relatively new awareness that unites environmental and ecological economists alike and led to this increasing number of methods in the field of environmental accounting.

14.2. Green GDP

In order to calculate the Green GDP, the conventional GDP is constructed, adding up benefits and costs. As already noted, in orthodox GDP defensive expenditure is added as a benefit, since GDP does not distinguish between a benefit and a cost. It does also not add or subtract commodities according to their final welfare effect. Smoking would be a cost rather than a benefit and clearing a forest might have some short term economic benefits, but also entails many (long-term) costs. GDP is simply compiling all commodities consumed within a certain period, nothing more and nothing less. The problem is, as already stated, that GDP is interpreted as a welfare indicator, although it is merely an indicator measuring economic throughput. No statements about the quality of throughput, let alone about social wellbeing, can or should be drawn from GDP numbers (Van den Bergh 2007:3, Costanza et al. 2009). Corrected GDP approaches try to overcome this shortcoming (Van den Bergh 2007:10, Veklich / Shlapak 2012, Alfsen et al. 2006:9).

Veklich and Shlapak (2012:246) argue that the Green GDP is particularly interesting for countries that economically mainly depend on natural resources. Comparing adjusted GDP with conventional GDP numbers allows the unraveling of the environmental cost of economic growth. Moreover, one can make assumptions concerning development potential and guide better policy strategies regarding natural resource management.

It has to be mentioned here that for calculating a Green GDP not the gross domestic or national product is taken, but rather the net domestic or national product. This is because the gross data does not subtract depreciation (Common / Stagl 2005:138f., Veklich / Shlapak 2012:246, El Serafy 1997:218, Pearce 2002:64f., Hamilton / Lutz 1996:2, Darmstadter 2000:12, Den Butter / Verbruggen 1994:190). There is a vast quantity of literature dealing with Net National Product (NNP) elaborating how NNP performs under imperfect market conditions (Aronson / Löfgren 1998).

Veklich and Shlapak (2012:245, Den Butter / Verbruggen 1994:188) define Green GDP "[...] as the

difference between estimates of traditional GDP and components of ecological correction […].” This definition leaves a lot of space for interpretation. The lack of an international standard defining which environmental commodities to include and how to measure, handle and aggregate them is one of the reasons Green GDP has not been very successful so far (Alfsen et al. 2006:7ff., Boyd 2007:717). Veklich and Shlapak (2012:245) identify three components of corrected GDP, which are “reductions in natural resource reserves”, “expenditure on environmental protection” and “environmental degradation.”

For economists probably the most seductive solution to illustrate environmental degradation in the national accounts correctly would be to produce a single number, a Green GDP. Apart from the simplicity of having just one number, the most important argument for substituting GDP with a corrected GDP is that GDP is simply flawed (Costanza et al. 2009:11). Several attempts were undertaken by different nations, but none of them was successful. One reason is the complexity of data needed to correct GDP; the other is monetary valuation (Veklich / Shlapak 2012:245).

In order to add or subtract environmental externalities from GDP, prices have to be attached to them (Costanza et al. 2009:13). Thus Green GDP is an indicator amending GDP (Costanza et al. 2009:11, Van de Bergh 2007:13). Including all the data necessary in order to construct a Green GDP is not an easy task and this is why no country was successful in producing such a Green GDP[79] (Van de Bergh 2007:13, Costanza et al. 2009:13f.). El Serafy (1997:218) even argues that “[...] a *comprehensive* coverage of environmental deterioration in the national accounts is not possible.”

One example of a GDP is the Sustainable National Income (SNI) developed by Hueting in 1974 and employed by the Netherlands. The SNI is calculated subtracting cost for environmental conservation from the NNP. One of the disadvantages of SNI is that it only focuses on environmental corrections, leaving blind social implications (Van de Bergh 2007:13f., Fasolo 2013:636[80]).

China was one of the countries that tried to compile a Green GDP. This effort was cancelled in 2007. Not only the problem of data collection led to this development. The data available already revealed the devastating result of a much lower Green GDP (Costanza et al. 2009:28, Boyd

79 Hamilton / Lutz (1996:17ff.) present the results of some green GDP calculations before and around 1993. Alfsen et al. (2006) compiled a report on green GDP (mainly on the SEEA approach).

80 Owen et al. (1997) write about the general problem that the new emphasize on environmental accounting resulted in the dismissal of social factors. The sustainability concept would, however, demand all three (economic, social and environment) spheres to be considered.

2008:7, Veklich / Shlapak 2012:245, Alfsen et al. 2006:32ff., Rauch / Chi 2010). From the consulted literature it is clear why satellite accounts are on the rise. Alfsen et al. (2006:35), analyzing China's attempt to calculate Green GDP, conclude:

> There is no doubt that green GDP would have been a very useful indicator if it could be calculated in a reliable manner. Thus, green GDP is a good concept, but unfortunately too unreliable and difficult to use it at present, due to the above theoretical, methodological and practical problems. This is not only the situation in China, but also worldwide. Actually, none of the countries in the world uses green GDP instead of conventional GDP. This is a very important international signal that China should take notice of.

14.3. Genuine savings

The Genuine Savings Indicator[81] (GSI) is another indicator amending GDP data (Costanza et al. 2009:11). The principle of the GSI is that savings within a period have to be greater than depreciation in order to allow the economy to be sustainable (Pearce 2002:65, Hamilton / Lutz 1996:7). In order to receive the GSI, environmental damage and resource depletion are subtracted from GDP. On the other hand investment in human capital is added, since this is seen as the engine for increased efficiency and thus contributes to sustainability (Asafu-Adjaye 2005:335f., Van de Bergh 2007:14, Fasolo et al. 2013:637, Costanza et al. 2009:11). The concept was developed by the World Bank, producing this indicator for more than 100 countries (published in World Development Indicator) (Pearce 2002:65, Costanza et al. 2009:11ff., Van de Bergh 2007:14, Fasolo et al. 2013:637, Hamilton / Lutz 1996:2).

Since developed countries usually have higher savings than developing countries the former are more sustainable, although this is not necessarily always the case (Pearce 2002:65). Costanza et al. (2009:14f.) refer to the findings of a World Bank publication from 2006 (*Where is the Wealth of Nations? Measuring Capital for the 21st Century*), explaining that a clear pattern of the share of capital endowments can be distinguished for developing, middle income and developed countries. The latter has the highest share of social and human capital (intangible capital) and the lowest share of natural capital. For developing countries the picture is upside down. Asafu-Adjaye (2005:337) states that especially for developing countries that are economically dependent on the natural commodities, the genuine savings approach can give some useful information.

Asafu-Adjaye (2005:336ff.) raises some points of criticism. For human capital investment the educational expenditure is used as a proxy, which is not the best one. The depletion of natural resources neglects some resources and thus is not a complete data set. Moreover, Asafu-Adjaye (2005:337) states that there are conceptual and technical problems of the method. Conceptual problems regard the assumption that the gross national savings equal investment, what not necessarily has to be the case. Additionally, the sustainability of investments depends on the type

81 See WB; the WB also launched a project together with TEEB (WB[2]).

of investment. Savings do not reflect their distribution. It moreover follows the weak sustainability concept, since man-made capital and natural capital are perceived as substitutes, is usual in neoliberal economics. The monetary valuation of natural resources reacts to changes in price, which in turn could lead to obscuring the real state of the environment. The technical critique relates to the one-dimensional calculation of pollution, only including CO_2. Natural resource depletion is limited to mineral and forestry resources. Other forms of natural capital, like carbon sequestration or biodiversity, are excluded as well, which is basically due to the valuation problems (Asafu-Adjaye 2005:336ff., Costanza et al. 2009:14). Van de Bergh (2007:14f.), moreover, points out that environmental depletion is not perceived as being a problem as long as the loss is compensated by another type of capital, thus GSI follows the weak sustainability approach. Summing up, it can be stated that GSI is criticized as being an imperfect index measuring welfare.

14.4. Index of Sustainable Economic Welfare/ Genuine Progress Indicator

Daly (1996), being an ecological economist, illustrates in his works the close relationship between economic activity and environment. His worries about choosing the right scale of economic activity are manifested in his analysis of GDP.

> [GDP] is a flow measure of consumption and production. As such it is largely the maintenance cost of the capital stock, a measure of the regrettably necessary activities of depletion, pollution, and labor that are required to maintain the capital stock against physical depreciation that inevitably accrues as the capital is used to satisfy wants. (Daly 1996:110)

Daly (1996:110ff.) illustrates that GDP adds up services (benefits), throughput (cost) and net accumulation (change in stock and funds). He argues that economists should rather compare the costs and benefits, instead of adding them up. For Daly this indicates the difference between micro- and macroeconomics. In microeconomics costs and benefits are compared in order to receive marginal utility. Since this is not required in macroeconomics, there is obviously no need to compare costs against benefits. Some economists argue that this is not necessary since GDP is based on microeconomics, where cost-benefit considerations were already done by every individual. Daly, however, states that these individual decisions do not take into account all the costs and benefits (social costs and benefits for the whole society). Moreover, he argues that this is a clear incident of fallacy of composition. Daly, in pointing out the difference between scale, distribution and allocation, suggests the construction of accounts for every single factor (Daly 1996:112f.)

Cost-benefit analysis on the macro level would allow us to see when the accumulation should stop because marginal utility is reached. So the economy should only grow to an optimal scale, a state where accumulation is satisfied. The optimum is reached when the carrying capacity of the

ecosystem is reached or nearly reached (precautionary approach). Such a goal is clearly opposing the GDP growth paradigm we are facing today (Daly 1996:114).

> Long before we have reached ultimate biophysical limits to growth in the scale of economy, we will have passed the economic limit beyond which the marginal costs of growth exceed the marginal benefits. No one can be sure that we have not already passed that point, since we do not even bother to count costs and benefits of growth. We just count economic activity in [GDP] and presume that its beneficial aspects outweigh its regrettable aspects (Daly 199:215).

According to Daly's (1996:100f.) perception of GDP growth and its measurement he suggests two amendments to GDP, which is to include the principle of depreciation and apply it as well to natural capital and to subtract economic activities that have negative environmental effects (e.g., cleaning after oil spill).

Following these considerations the *Index of Sustainable Economic Welfare* (ISEW) was constructed. The ISEW is, however, not the first attempt to correct GDP. The *Measure of Economic Welfare* (MEW) developed by Nordhaus and Tobin in the beginning of the 1970s was the predecessor of ISEW (Fasolo et al. 2013:636, Costanza et al. 2009:12). ISEW is an economic welfare index, based on GDP but corrected for income distribution, natural resource depletion and foreign debt, among others. The ISEW was developed in the end of the 1980s by Daly and Cobb (Daly 1996:97, Constanza et al. 2009:12, Van de Bergh 2007:12f., Fasolo et al. 2013:636). Daly and Cobb calculated the ISEW index for the USA for the period 1950 to 1980. They compared the data with GNP and found that from the 1970s on the growth pattern changed. GNP went on rising, while ISEW decreased (Daly 1996:97, see also Constanza et al. 2009:13). With this calculation they illustrated that GDP growth is detached from welfare. Daly (1996:98) argues that even if the ISEW is not a perfect measure, it is at least not worse than GDP; in fact, he states, it is a better one. Daly himself was generally not in favor of using any index or indicator. He even thought that the world would be better off without such an index.

In the mid-1990s the ISEW was reviewed and the *Genuine Progress Indicator* (GPI) was developed. GPI is again based on GDP but examines whether GDP is sustainable or not. This is done by subtracting adverse economic activities from GDP and adding positive ones. Hence GPI is an index showing the sustainability of economic activity, rather than merely economic activity (Costanza et al. 2009:12, Costanza et al. 2013:129f., Van de Bergh 2007:13, Fasolo et al. 2013:636, Kubiszewski et al. 2013:57f.). It has to be pointed out that GPI is a measure of sustainable economic welfare, rather than of sustainability. In order to analyze sustainability GPI should be viewed together with biophysical data (Kubiszewski et al. 2013:58, El Serafy 1997:218).

Kubiszewski et al. (2013:58) emphasize that there can be no indicator for sustainability, since this cannot be measured *ex ante* but rather *ex post*. This is already pointed out by El Serafy (1997:220). She states that the concept of sustainability is normative.[82] Measuring sustainability, however, needs positive analysis methods. The analysis, even if undertaken *ex post*, covers only one year. Strong sustainability calls for a long-term perspective, thus national accounting cannot be a proper tool to evaluate or guide sustainable states (Pearce 2002:65).

ISEW and GPI illustrate Max-Neef's *threshold hypothesis,* indicating that at a certain point GDP growth does not bring about increases in welfare. Max-Neef (1995) shows this using the ISEW in his paper *Economic growth and the quality of life: A threshold hypothesis*. It is revealed that from around the 1970s ISEW or GPI levels off, while GDP keeps on rising (Costanza et al. 2009, Van de Bergh 2007:13, Kubiszewski et al. 2013[83]). Max-Neef (1995:117) draws an analogy to the KC. But instead of improving conditions after a threshold, the situation gets worse with rising GDP. If calculations are correct, these results call for the implementation of a steady state economy, as Max-Neef points out (Kubiszewski et al. 2013:67).

The reason for ISEW or GPI leveling off at a certain level can be found in the "[..] substitution of informal household production by services provided by the market (e.g., child care), increased inequality, natural resource depletion, and the emergence of environmental problems (global warming, acid rain, biodiversity loss)" (Van de Bergh 2007:13, Kubiszewski et al. 2013:66).

Van de Bergh (2007:12) points out that such indicators that try to correct GDP also have their shortcomings, notably regarding non-market valuation, technological innovation, changing prices, and how rivalry influences wellbeing. However, after comparing several corrective GDP indices, he concludes that although there is no perfect measure, ISEW and GPI are the most complete corrections to GDP. Giving these two indices the top mark among the evaluated is, for Van de Bergh, nevertheless a reason to keep on using indices including GDP. However, as long as policy makers and the private sector strive for GDP growth the obsession would be transferred from GDP to GPI (Van de Bergh 2007:15f.).

Van de Bergh's argument is indeed a true and necessary warning. The main challenge is to defeat growth fanaticism. ISEW and GPI were, however, not developed to further promote growth; the

82 Common and Stagl (2005:6) illustrate the ethical implications of normative and positive science.

83 They compare not only GDP with GPI, but also with other indicators: Ecological footprint, Biocapacity, HDI, Life Satisfaction, Gini coefficient. They compare the data for 17 countries between 1950 and 2010. The result reveals that in most cases the only index constantly rising is GDP, while all the other indicators either decline or level off. The aggregated data for the 17 countries again illustrates this pattern (see Fig.2, page 63).

contrary is the case. The developers want to illustrate that there is a huge difference between mere GDP and GPI (Bartelmus 2013:2). This fact is nicely shown through the threshold hypothesis. The authors of GPI want to show that at a certain point GDP growth is uneconomic (Kubiszewski et al. 2013:58).

> Since [GPI] is made up of many benefit and cost components, it also allows for the identification of which factors increase or decrease economic welfare. Other indicators are better guides of specific aspects. For example, Life Satisfaction is a better measure of overall self-reported happiness. By observing the change in individual benefit and cost components, GPI reveals which factors cause economic welfare to rise or fall even if it does not always indicate what the driving forces are behind this. It can account for the underlying patterns of resource consumption, for example, but may not pick up the self-reinforcing evolution of markets or political power that drives change (Kubiszewski et al. 2013:58).

The creators and advocates of GPI seem to be duly aware of the general shortcomings of aggregate indicators (Kubiszewski et al. 2013:58). Nevertheless, they are employed in order to show that GDP data is misleading and to break the GDP fanaticism (Costanza et al. 2009:27, Owen et al. 1997:180).

In contrast to Green GDP and satellite accounts, GPI has the great advantage of being applicable (Kubiszewski et al. 2013:58, Costanza et al. 2009:25). It was noted before and will be stated in the next section, that other attempts to correct GDP or to relate GDP to biophysical data suffer from the problem of lacking data and the huge efforts and costs necessary to calculate them. Indeed, as Costanza et al. (2009:25) point out, GPI is also suffering from the problem of data availability in some countries. However, given that GDP was developed in the 1930s, there was much more time to arrive at this level of accuracy and consistency that GDP has today. If environmental accounting got the same attention, funding and time, the same degree of accuracy could be achieved (Boyd 2008:9).

14.5. Satellite accounts

Another possibility is to produce satellite accounts that are included in the System of National Accounts (SNA). GDP is derived from the SNA, which is an international framework defining how economic data is collected and aggregated (Costanza et al. 2009:4, Hamilton / Lutz 1996:5). These satellite accounts are reported in physical units, thus the hurdle of attaching prices on non-market commodities is omitted. Nations can collect the data and compile them within the SNA. Apart from not needing to attach monetary value to the commodities, countries can focus on information that is of interest for them (Alfsen et al. 2006:19). This has two disadvantages. First, if countries do not collect the same data, comparison is difficult. Second, the interpretation of this data is left to the user (Alfsen et al. 2006:9). Boyd (2008:6) suggests installing satellite accounts as a kind of interim step for the construction of a Green GDP. Hence as long as the shortcomings of

Green GDP methods are not solved, satellite accounts allow the collection of data and still leave GDP untouched.

El Serafy (1997:218) explains why it makes sense not to translate all biophysical indicators into monetary units. Accounting is an economic tool, which might *per se* be limited in tracing environmental change. Measuring change in physical terms might thus be more useful and significant than the SNA.

Using satellite accounts has several advantages. GDP keeps unchanged and thus the consistency over time is not threatened. Especially as long as methods and frameworks for environmental accounting are not clear and require many readjustments, it seems to be more convenient to use satellite accounts keeping GDP sovereign. Moreover, one omits the problem of translating other qualitative and or quantitative data into monetary units. This also has the advantage that changes in stock or flow are not obscured through changes in prices (Costanza et al. 2009:21, Common / Stagl 2005:157, Smith 2007:597). Having satellite accounts, the data are more transparent and it is up to the user to interpret them. Producing only one single number, as is the aim of Green GDP, is based on the assumption of complete substitutability. This means that trade-offs can be made between all kinds of commodities. For certain commodities this is simply not the case, since human beings need them in order to survive. An economy cannot make the trade-off increasing the financial capital stock at the expense of minimal air quality needed for human bodies to work properly. Of course theoretically this is possible, but practically it is at least politically not. Additionally, it is obvious that such a trade-off does not lead to equal wellbeing for the population (Van den Bergh 2007:4ff.). And finally, for many GDP is still a useful indicator, which they simply do not want to dismiss (Costanza et al. 2009:11).

The most prominent framework on satellite accounts is the *System of Environmental and Economic Accounts*[84] (SEEA) issued in 2003. It can be traced back to the revised SNA of 1993.[85] The SNA 93 already offered some improvements concerning natural resources but these were by far not sufficient, which is why further improvements were needed (Smith 2007:592). Also in 1993 an interim publication produced by the United Nations Statistics Division was published, dealing with the integration of environmental commodities into the SNA. The *Handbook of National Accounting: Integrating Environmental and Economic Accounting* (SEEA 93) was the first serious attempt at establishing national accounts that include environmental commodities (Smith 2007:593,

84 See SEEA's official webpage: http://unstats.un.org/unsd/envaccounting/seea.asp [04.10.13]; the handbook is available under: http://unstats.un.org/unsd/envaccounting/seea2003.pdf [04.10.13]. There is a special Issue of Ecological Economics on SEEA (http://dx.doi.org/10.1016/ [04.10.13]).

85 The history of SEEA is outlined in the white cover publication (N/A 2012).

Asafu-Adjaye 2005:330, El Serafy 1997:221, Hamilton / Lutz 1996:2, Den Butter / Verbruggen 1994:191f., Bartelmus 2013:2). Since then various countries established national accounts including the environment. However, it has to be pointed out that none of these countries established full accounts. Rather, every nation focused on aspects particularly interesting to them[86] (Smith 2007:593ff., Alfsen et al. 2006:19ff.). In 1998 the United Nations Statistical Commission called for the revision of SEEA 93, which resulted in the *System of Environmental and Economic Accounts 2003* (SEEA 2003, Smith 2007:593, Alfsen et al. 2006:19).

It was already pointed out that a major problem concerning green national accounts is the lack of data and its inconsistency (Boyd 2008). SEEA provides a framework in order to align global efforts (Alfsen et al. 2006:20). In 2007 Smith criticized that SEEA version 2003 was not an international standard and that the quality of collected data cannot be guaranteed by the framework and is left to the operators (Smith 2007:594f.) It is not at least due to these data problems and the huge costs and effort associated that no country implemented the whole framework. This is true for the old SEEA 39 as well as for SEEA 2003 (Smith 2007:595). However, in 2012 SEEA was revised and it remains to be seen how SEEA will progress in terms of implementation.

This approach is promoted by *United Nations* (UN), *International Monetary Fund* (IMF), the *Organization of Economic Cooperation and Development* (OECD), the *Statistical Office of the European Communities* (Eurostat) and the *World Bank* (Costanza et al. 2009:21, Common / Stagl 2005:157).

The SEEA framework presents four different categories for how environmental data can be analyzed (Costanza et al. 2009:22, Smith 2007:594ff., Alfsen et al. 2006:20f., N/A 2013:14):

1. physical accounts: These accounts are only capturing physical units, while two different approaches are suggested: one only outlining flow data in physical units and one which confronts the physical data with economic data. The latter are so-called hybrid flow accounts.
2. Expenditure accounts: These accounts indicate costs and benefits of environmental protection and management.
3. Natural resource accounts: They serve the identification of stocks of resources in monetary and physical units. Such stocks are, for example, forests, where the monetary value and the physical stock can be identified.
4. Monetary accounts that indicate the value of non-market commodities. This section

86 A famous example is the *National Accounts Matrix including Environmental Accounts* (NAMEA) developed by the Netherlands, which focuses on pollution (Smith 2007:593). According to Alfsen et al. (2006:20) NAMEA is a hybrid account.

indicates how SNA accounts can be adjusted considering the effect of the economy on the environment. Three different corrections are suggested: defensive expenditures, environmental depletion and environmental degradation.

SEEA 2003 was again revised and resulted in the publication of SEEA *Central Framework* in 2012. *The United Nations Statistical Conference* adopted SEEA 2012[87] as the first standard for environmental-economic accounting (UNSTATS, Bartelmus 2013:3). The SEEA 2012 is part of the *Central Framework*, which also includes *Experimental Ecosystem Accounting and Applications and Extensions*. For the former a white cover version exists already; for the latter only drafts are available. Apart from the *Central Framework* there are three subcategories which focus on Energy, Land and Ecosystems and Agriculture (UNSTATS, UNSTATS[1]).

14.6. Limitations of green accounting

Although much progress has been made in the field of green national accounts there are still limitations that are probably impossible to overcome. Asafu-Adjaye (2005:333ff.) indicates that there is, for example, dissent among economists on how to integrate defensive expenditure and pollution damage in the national account. Moreover, the already stated problem of attaching monetary value to non-market commodities remains problematic. The SEEA elegantly circumnavigates this problem, but if the aim is to ultimately produce a single number this problem will remain. Asafu-Adjaye (2005:334) indicates another highly interesting point, that of transboundary environmental problems such as pollution or climate change. How should such aspects be included in national accounts?

Due to the shortcomings of GDP and the various indices correcting GDP have, not using GDP or GDP related indicators is suggested. Therefore, I will again discuss general shortcomings of GDP and even more generally the problem of measuring. Then alternatives to GDP, corrected GDP and satellite accounts will be presented.

14.6.1. Abolishing GDP

Van de Bergh (2007) pleads in his paper to abandon GDP, as it is a measure that leads to many distortions because it is taken for something that it is not; an indicator to measure welfare. He not only discusses the shortcomings of GDP and indices that try to correct GDP; he also points out the advantages of abandoning GDP. One of the most important factors I want to mention here is the greater willingness to implement measures to mitigate environmental damages and to install policies that prevent environmental degradation and pollution. So far most policies are not adapted

87 Bartelmus (2013) provides a comparison of the SEEA 93 and the SEEA 2012 version.

if they jeopardize GDP growth. A nice example of the influence of GDP fixation is the development of UNEP's Green Economy concept, which could only receive great attention after *promising* that a transformation toward a Green Economy is compatible with GDP growth.

Van de Bergh (2007:16) points out that many people believe in GDP and orient their decisions according to GDP numbers. Due to the shortcomings of GDP he strongly pleads to abandon GDP.

> Given the many shortcomings of GDP as a measure of social welfare and the economy-wide effects, one has to expect a large loss of social welfare, certainly in the long run – when repeatedly and cumulatively false information steers economic decisions. Currently, economists are insufficiently aware of this potentially huge cumulative negative impact of GDP over time. In fact, I am inclined to think that there is no larger information failure in the world than that caused by the GDP indicator (Van de Bergh 2007:16).

Van den Bergh (2007:2) indicates that GDP growth in itself is not an intergenerational goal, stating that even if GDP can theoretically grow infinitely, this does not mean that it is economically profitable (Daly 1996). Therefore the argument is obvious to dismiss GDP at all.

Van de Bergh (2007:11f.) gives some popular arguments why GDP should still be used and outright invalidates them. Then he presents some alternatives to GDP. He simply argues that since GDP is misleading or, more precisely, is incorrectly interpreted as a welfare indicator, it should be abolished. Apart from this the “threshold hypothesis” illustrates that from a certain point onward GDP growth is delinked with other welfare indicators. Thus from this point onward GDP has no useful information anymore, apart from throughput (Van de Bergh 2007:12, Rees 2001:8). Van de Bergh (2007) also discusses several indices that are based on GDP but try to correct it. He (2007:6) questions for example whether the significance concerning social wellbeing is increased if externalities are internalized. Again he comes to the conclusion that these corrections cannot offset the shortcomings of GDP. He states, “[..] it turns out that, at present, there is no perfect alternative available” (Van de Bergh 2007:15). The general inaccuracy of GDP leads to the conclusion that it is probably better not to use it at all. Van de Bergh (2007:10) states that some politicians excuse their focus on GDP stating that it is not the only macroeconomic indicator and subsequent economic goal used and pursued. As Van de Bergh (2007) correctly notes, adding other indicators to an inaccurate indicator does not annihilate the inaccuracy.

In the GDP infatuated world it is almost typical that Van de Bergh (2007) somehow has to legitimize his position and has to explain that abolishing GDP is not that evil at all. Being against GDP measurement results in people pigeonholing one as being anti-economic. Immediately one is stereotyped as being against economic progress and innovation. Van de Bergh (2007:17f.) points out that this is not the case. Rather than being against GDP growth he is against measuring it because it is not important. GDP growth which promotes increasing welfare is not abolished only

because it is not measured anymore. Growth should not be seen as the only precondition to increase welfare. Sometimes it does even the opposite. Hence all Van de Bergh is pleading for is to abandon this GDP growth fixation. He argues similarly to Daly (1996), contrasting between the developed and developing world. He indicates that after a certain threshold when growth becomes uneconomic, it should no longer be pursued. On the other hand, below this threshold GDP growth can be a desirable thing. Thus growth should, however, not necessarily follow the pattern of developed countries. For example, increasing GDP and increasing the gap between poor and rich within the country does not improve general welfare and should not be the goal of economic progress. Or GDP growth at the expense of environmental health, which has negative impacts on human lives and thus welfare, should also not be pursued. Innovation that leads to more efficiency and decreases GDP growth, on the other hand, is promoted. This is to decrease throughput – manifested in GDP – and thus the negative impact of economic activity (Van de Bergh 2007:17f.).

Constanza et al. (2009:28) points out that the reason GDP is not abandoned is not only reasoned in human fixation on GDP brought about by over 70 years of public brainwashing. It is simply vested interests[88] that promote the regency of GDP. Costanza et al. (2009:29ff., see also Boyd 2008:5) thereafter try to identify the way forward, which would need a lot of political will to not only abandon an indicator but even to abandon the mindset that underpins the current economic system. Concentrating on other indicators also means concentrating on other goals. Changing people's mind is already a hard task, but I think that the even harder task is to break the influence and power of stakeholders that have great interest in keeping GDP. Constanza et al. (2009:31f.) point to the current economic crisis and state that this is an indicator for setting wrong goals. They indicate that such a crisis is a chance to change direction. It is symptomatic that concepts that would offer a fundamental change are diluted to serve those that are not willing to accept a world without GDP domination. UNEP's Green Economy concept is a good example and will be discussed in the next section.

Daly is also one of the scientists representing the opinion that GDP should be abandoned, even though he developed ISEW. One interesting analogy that he draws illustrating the general trickiness of indicators has to be mentioned here. He refers to the Heisenberg principle and explains it with a clinical study. In order to measure the healing process of tuberculosis the medical personnel had to count the coughs. Although the coughs, which were seen as health indicator, diminished, the number of deaths did not decrease. This was because coughs are just a symptom and not the cause. However, it was supposed as being the same (Daly 1996:42). The same is true

88 See, for example, Boyd (2008), who tells that the U.S. Government inhibits the development and implementation of green national accounts.

for the GDP. One has to be careful what GDP ought to measure and what it really does measure.

14.7. Indicators not using GDP

14.7.1. Subjective wellbeing

Another group of indicators try to capture the emotional wellbeing of people. *Gross National Happiness* (GNH) is one of these indicators that received most attention in the last years due to Bhutan's efforts in this field (Bhutan, Bartelmus 2013:2).

These approaches try to capture human satisfaction or happiness in order to evaluate the state of wellbeing within a nation (Costanza et al. 2009:16ff., Common / Stagl 2005:198ff.). Actually this approach is nothing new. As Common and Stagl (2005:200) state, for economists in the 19th century happiness meant utility, a view which was abandoned by neoclassical economists by 1950, and happiness was not measured anymore.

The greatest critique is that these indicators are based on subjective statements, rather than objective data. Costanza et al. (2009) point out that objective data are only proxies of wellbeing, which are interpreted through humans' subjective ideas. Other critical matters of discussion regard cultural differences which ostensibly make comparison of the results difficult. Let us just accept this argument; GDP might, however, also not be a good proxy for wellbeing. GDP might be objective and comparatively easy to measure, but we already know that it does not say much about people's wellbeing, happiness or life satisfaction (Van den Bergh 2007:5). Hence we can choose between an indicator easy to handle, but which is taken for something what it is not or we take another indicator (or indicators) that is more difficult to use but more closely measures what we want to measure.

However, results show that beyond a certain GDP happiness does not increase substantially anymore: "[...] the reasonable conclusion is that economic growth is very important for improving human well-being at income levels typical of the developing world today, but not very important in that respect at income levels typical of the developed world today" (Common / Stagl 2005:200). Common and Stagl (2005:204) go on pointing out that "[e]ssentially there is no relationship between average income as measured by GDP and this measure of national happiness. This is what turns out to be the case for virtually all of the rich economies for which data is available over a few decades or more – GDP per capita grows steadily while happiness remains unchanged."

Here we see the analogy to the utility concept. The marginal utility of one additional unit declines the more someone already has (Common / Stagl 2005:203f., Van de Groth 2007:6). Common and

Stagl (2005:205) argue that since in rich countries happiness does not rise substantially anymore, *Ecological Economics* do not focus and promote economic growth in rich nations. The fact that people, although they increase their financial wealth, do not experience the same increase in happiness is reasoned through the stable relative distance to other people. Hence people compare their own wealth with the wealth of others and not being at the same level is a source of unhappiness. Accordingly, inequality should be diminished, because first, the poor have higher marginal happiness gains than the rich have. So it is a question of effectiveness. Second, inequality is in itself a source of unhappiness (Common / Stagl 2005:204f., Van den Bergh 2007:5ff.). "If it is accepted that the point of economic activity is human happiness via the satisfaction of wants and needs, and that poverty is a problem to be addressed, then inequality does matter, and growth alone is not enough" (Common / Stagl 2005:205, Lintott 1998: 242ff.). This circumstance was already pointed out by Easterlin in 1974. Similar to the threshold hypothesis, the *Easterlin Paradox* indicates that income is not the only factor influencing life satisfaction or happiness. Easterlin (1974) also showed that although happiness within a country correlated with increasing income, poor countries do not have lower happiness results than rich nations. Apart from this there might be more factors influencing the perception of happiness or life-satisfaction (Di Tella / MacCulloch 2008).

The "threshold theory" was already pointed out and does apply to the pattern of subjective wellbeing and GDP (Costanza et al. 2009:17). At this point I want to draw our attention again to the affluence or sufficiency debate. We acknowledge that in orthodox economic theory GDP growth is equalized with growth in wealth, in utility, in happiness. This is why increasing consumption is important. However, taking into account the finding concerning happiness and GDP data, concerning the "threshold hypothesis" we find that from a certain point onward further consumption, hence further GDP growth, does not increase our utility or our happiness. This finding supports the sufficiency strategy (Alcott 2008:771). Sufficiency would mean to stop when consumption does not increase our happiness anymore. Moreover, Common and Stagl (2005) pointed out that the relative income differences matter in terms of happiness. Hence if we want to make people happier, we have to diminish the income differences. The steady state concept exactly wants to achieve this goal. The richer ones should cut back their throughput while the poorer ones have the right to increase their throughput (Daly 1996).

14.7.2. Material and Energy Flow Accounting (MEFA)

It was already pointed out that *Ecological Economics* is rooted in considerations about human-nature interactions. The efficiency of a process in *Ecological Economics* is not only measured using monetary units, but also through biophysical units. Hence the goal is not merely to get more

money out than we put in, but rather to put less material and energy in, in order to get a certain output. For those economists who concentrate on the material base, to keep it within stainable limits, physical flow measures are more important (Bartelmus 2013:2, Wackernagel et al. 1999). Accordingly, one can employ material and energy input analysis, hence we need material and energy flow accounting (MEFA).

Although input-output considerations are common in economics the idea of MEFA stems from ecology, thus from natural science. Suh (2005) argues that in both disciplines the MEFA approach developed separately. One major difference between the two approaches is based on the different focus both disciplines have. Ecology is supply, while economy is demand driven. Hence in ecology the question is how supply (inputs) influences the whole system. In economics, in contrast, it is analyzed how demand influences the system. Suh (2005) argues that such a point of view would be ridiculous for ecology, since this would entail asking a question like how diminished fish stock influences the growth of plankton. It is ridiculous because ecologists are focused on the factors that permit life. So the question would rather be how much fish can be fed by a certain amount of plankton. One can easily see that the focus is on the conditions to sustain life. Moreover, Suh (2005) explains that MEFA within ecology also tries to analyze the interrelations between various factors. However, it is still acknowledged that due to the interconnectedness, complexity and uncertainties MEFA does only provide a snapshot and does not allow giving predictions. This is in sharp contrast to orthodox economics, where models are developed in order to give predictions.

Haberl et al. (2004:203f.) argue that the newer MEFA research provides data that is compatible with statistical data and thus allows one to draw connections between the biophysical and the socio-economic data. “By means of this ‘double compatibility’ – towards ecological and socio-economical models and data – the socio-economic metabolism approach can establish a link between socio-economic variables and biophysical patterns and processes [...]” (Haberl et al. 2004:204). Thus MEFA data can be incorporated in the SEEA framework (Hinterberger et al. 2003, EUROSTAT 2001:10f., Fischer-Kowalski et al. 2001:860). Fischer-Kowalski et al. (2001:856), for example, indicate that MEFA data can unravel to what extent decoupling is reached by comparing MEFA with GDP data (see for example EUROSTAT 2002, UNEP 2011[2]).

It was already indicated several times that *Ecological Economics,* in contrast to *Environmental Economics*, is based on considerations regarding human-nature interaction and acknowledges nature as the basis for human existence. Hinterberger et al. (2003:2, EUROSTAT 2001:11, Fischer-Kowalski et al. 2001:859), for example, argue that

> [a]ccording to the first law of thermodynamics (the law of the conservation of mass), total inputs must by

definition equal total outputs plus net accumulation of materials in the system. This material balance principle holds true for the economy as a whole as well as for any sub-system (an economic sector, a company, a household).

Therefore, *Ecological Economics* is not so much focused on the demand,[89] but rather on the supply. However, not only the inputs but also the outputs are assessed and analyzed in order to draw conclusions about, e.g., the sustainability of a socio-economic system.

Ecological Economics' preanalytic vision and the MEFA's basic conceptions are very similar. Both are based on the notion of nature-human interaction, while the human sphere is seen as a subsystem of the environmental system[90] (EUROSTAT 2001:11). Considering these similarities, it is only logical that MEFA is a tool which fits into
Ecological Economics' analytical interests.

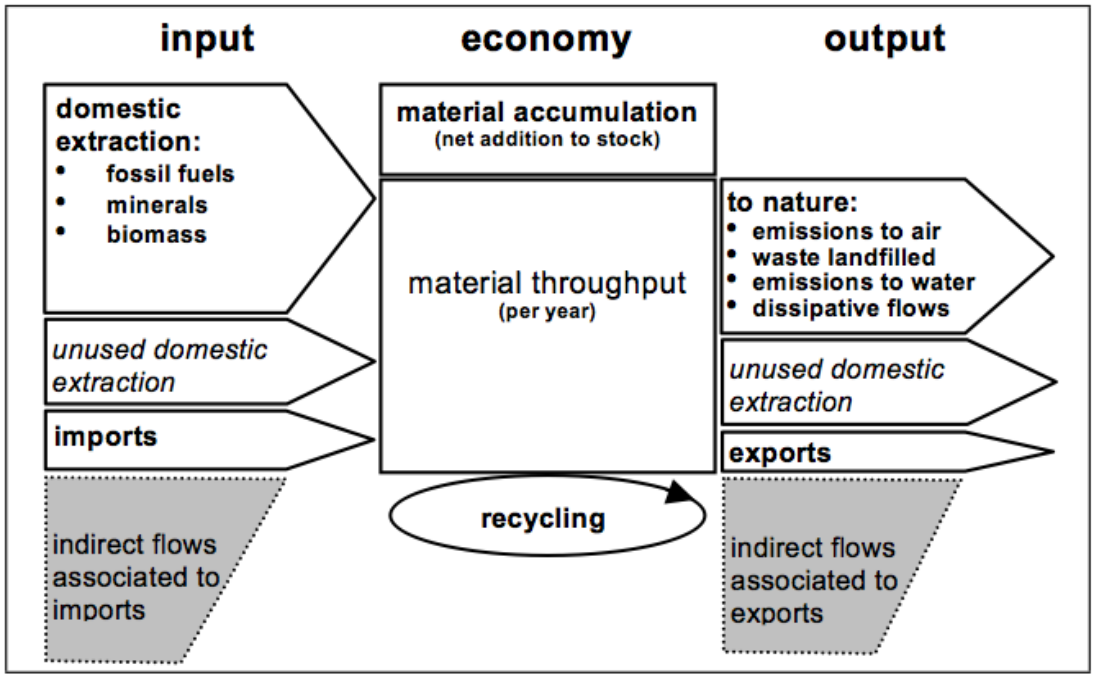


Figure 17: MEFA framework (EUROSTAT 2001:16, compare e.g. with Fischer-Kowalski et. al (2001:860, Figure I)

MEFA allows us to show how much and on which material and energy a society lives. This allows

89 Demand issues are also analyzed since this can reveal which world regions import more than they export, what economic sector is export based or which regions bear the burden from resource export and which profit from it.

90 Note that in social-ecology the humans are perceived as being part of two systems which overlap: the natural and the cultural systems. Hence, humans are not only dependent on the environment, but also on culture. The way humans live is influenced by both factors. On the other hand, nature and culture influence each other (Haberl et al. 2004). One can say that through a coevolutionary process both adapt to changes. Therefore, the environmental awareness, which can be more and more observed in society, is a coevolutionary result, as the modern culture influenced the environment, and now the changed environment again affects society and forces a reaction.

historic analysis of the socio-economic metabolism. Three socio-economic eras can be distinguished, while the one we live in now is the first one in which humans do not depend on renewable energy carriers (Haberl et al. 2011, Haberl et al. 2004, Fischer-Kowalski et al. 2001:856). Analyzing inputs and outputs of different socio-economic systems, one cannot only illustrate historic differences, but also analyze the eco-efficiency or the sustainability (Haberl et al. 2004, EUROSTAT 2001:37).

It is argued that MEFA does not only allow analysis of how sustainable the socio-economic metabolism is but also that "[k]nowing how material and energy flows are related to economic activity or to social well-being would greatly enhance our understanding of socio-economic driving forces of environmental change as well as our ability to change our behaviour" (Haberl et al. 2004:200). Thus MEFA is a good tool to illustrate relationships between the environment and the socio-economic world and provides policymakers with a more holistic picture and thus base for decision making (Hinterberger et al. 2003:8, Fischer-Kowalski et al. 2001:861).

Haberl et al. (2004:203) argue that there are several indications illustrating that the current socio economic metabolism is unsustainable and thus change is needed (see, for example, Meadows et al. 2009). Therefore the strategy and the aim is not to wait until change is unavoidable due to ecosystem collapse, but rather to induce change as early as possible in order to promote a smooth transition.

However, MEFA assesses what material and energy flows (e.g., biomass) into the social system, the share that stays there for a while, the share that is flowing out of the system as waste and which share is imported and which is exported (Hinterberger et al. 2003:4). Haberl et al. (2004) point out that the matter and energy staying in the system for a certain time as stocks (e.g., buildings) result in subsequent energy and matter requirements in order to maintain these stocks. Apart from that, the area which is occupied (or colonized, as it is called in the language of social ecology) by humans affects the primary production. Hence colonization can lead to surface sealing, which results in foregone output from the environment (net primary production [NPP]). Apart from man-made stocks humans themselves build a stock within the socio-economic system. Their number is important since every human needs a minimum amount of matter and energy to survive and thus the number of people as well as their lifestyle tells much about the maintenance requirements (Fischer-Kowalski et al. 2001:859). All these flows, and stocks can be analyzed and conclusions can be drawn from it. Anyway, Haberl et al. (2004, see also Hinterberger et al. 2003) admit that it is not always easy to draw conclusions concerning sustainability from the data. Nevertheless, MEFA is a useful tool, providing sustainable development indicators (Hunag 2012).

Many different indicators are used to calculate MEFA. First, it is distinguished between direct and indirect flows. The former only accounts for the final weight of the final product, while the latter also takes into account all matter and energy flows that were required to produce the final product (e.g., using live cycle assessment [LCA][91]). Second, one can distinguish between used and unused flows. Used flows are those matter and energy flows that actually flow into the economic system, becoming a part of real consumption. Unused flows are energy and matter flows that are byproducts of production processes, which do not become part of a final product. And last, one can differentiate between domestic flows and import-export flows (Hinterberger et al. 2003:3, EUROSTAT 2001:15ff., Fischer-Kowalski et al. 2001:861). Apart from these flow indicator categories it is distinguished between input, output and consumption indicators[92] and the physical trade balance (PTB) (Hinterberger et al. 2003:5, EUROSTAT 2001:21, Fischer-Kowalski et al. 2001:861f.). The data derived can be presented in different ways:

- Metabolic scale: aggregate data showing the total dimension.
- Metabolic rate: (DMC/capita*year) indicating how much resources are needed to maintain a single inhabitant.
- Material intensity: (DMI/ $GDP*year) indicating the productivity of a certain economy.
- Material burden: (DE/hectare*sear) indicating the pressure or burden of domestic extraction on a given territory (Fischer-Kowalski et al. 2001:861).

Life cycle assessment (LCA) and input-output (IO)[93] analysis are part of *Ecological Economics* right from the beginning. As was explained in the history of *Ecological Economics,* the intellectual fathers were not economists but natural scientists. The idea that all inputs of the final product matter in order to assess the efficiency of a product and the production process was pointed out, for example, by Martinez-Alier (1987), reflecting the work of Podolynskyj or Sacher (see EUROSTAT 2001:38). Fischer-Kowalski et al. (2001:857) trace back the roots of MEFA to Robert Ayres (and Allen Knees), who presented in the second half of the 20th century (100 years later than Podolynskyj or Sacher) the first version of a MEFA. Anyway, since then MEFA is a commonly used method which is also promoted by the European Union[94] (Fischer-Kowalski et al. 2011:858f., EUROSTAT).

91 For more about LCA see Hinterberger et al. (2003:6).
92 Direct material input (DMI), total material input (TMI), total material requirement (TMR), domestic processes output (DPO), total material output (TMO), domestic material consumption (DMC), total material consumption (TMC) (Hinterberger et al. 2003:5, EUROSTAT 2001:35f.). A classification of material inputs and outputs as well as of stocks is given in EUROSTAT (2001:28ff.)
93 For more about IO see Hinterberger et al. (2003:6)
94 See for example EUROSTAT (2002), which is a MEFA study from 1980 to 2000.

In comparison to the Ecological Footprint (EF) MEFA is able to distinguish between non-renewable energy carriers and renewable ones. And even within the latter category it can be differentiated whether the resource is extracted from a managed or from an unmanaged stock (Haberl et al. 2004:205f.). Thus MEFA data not only provides quantitative but also qualitative data (Fischer-Kowalski et al. 2011:856).

Haberl et al. (2004:204, Hinterberger et al. 2003:9f.) argue that MEFA is not completely mature and further developments would be needed. However, it already gives an alternative to the classical economic analysis. Fischer-Kowalski et al. (2011), analyzing the conceptual, the standardization and reliability level of the method and data, conclude, “The achievements in material flow accounting to date suggest that this framework adds important information to the leading aggregates, such as population, GDP, income, employment, and consumption, and will therefore challenge the traditional economic information for national policy making in the context of sustainable development” (Fischer-Kowalski et al. 2011:870).

One amendment is the inclusion of land use and land change data, which can be captured through human appropriation of net primary production (HANPP), which will be explained below.

14.7.3. Net primary production (NPP) and human appropriation of net primary production (HANPP)

Net primary production (NPP) was already explained above, elucidating the role of thermodynamics for *Ecological Economics*. Calculations about the solar radiation inflow, the amount of absorption and reflection have been possible since the 1850s, which is the basis for NPP calculations (Martinez-Alier 1987:49).

To repeat, NPP is the plant growth within a given period determined by solar radiation, climate and eventual management practices. As human lives as well as most of human activities depend on the photoactive capacity of plants and the stock they built up, NPP is an indicator stating environmental wealth on a given territory (Haberl et al. 2004a:279, Haberl 1997: 143). NPP is combined with the concept of carrying capacity, which is the maximum population number that a certain patch of land can sustain without diminishing its supportive capacity. Thus the NPP/K ratio illustrates nature’s supply, and how much of this is consumed, or if it is already used up, what would be unsustainable (Vitousek et al. 1986, Haberl 1997:143).

Human appropriation of net primary production (HANPP) is an indicator showing the intensity of human use of nature (Haberl et al. 2004[a]:279, Haberl 1997:144). HANPP is a tool to measure colonization by humans. Thus it compares the potential NPP with the actual NPP (see Figure 18)

(Haberl et al. 2004:207). The HANPP framework can be extended to various kinds of resource types, like standing crops, water or the efficiency of agriculture (Haberl et al. 2004:207). Depending on the research question HANPP can be expressed in different units or as ratio of potential NPP (Haberl et al. 2004[a]:283).

It is assumed that a shrinking NPP and increasing HANPP have negative effects on the ecosystem. This is, for example, due to the negative effects of GHG emissions, the loss of biodiversity and thus the loss of ecosystem services like water purification (Haberl et al. 2004[a]:283).

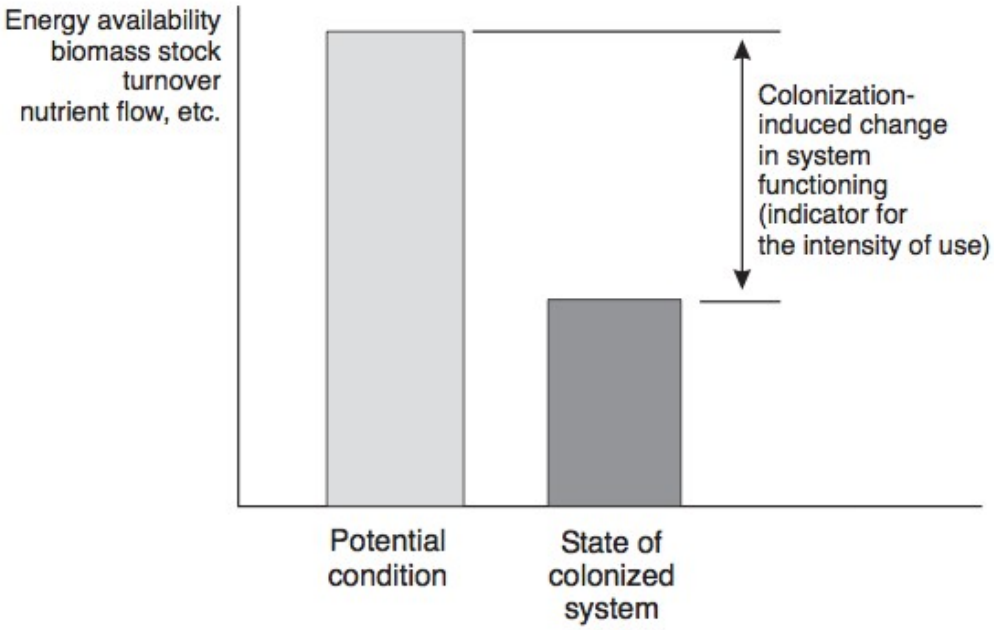


Figure 18: Potential and actual NPP (Haberl et. al 2004:207)

Haberl et al. (2004[a]:283) argue that compared to the EF, HANPP has two major shortcomings. One is that it does not tell which HANPP is desirable, matching with sustainability goals. As will be shown below EF has a very simple approach and clearly illustrates when the carrying capacity of a territory is exceeded. Another issue is that HANPP does not give indications about domestic and external demand. Due to international trade HANPP can be high in one country and low in another one. Who is the end-consumer is not captured in HANPP (Haberl et al. 2004[a]:283). However, the embodied HANPP approach, for example, tries to overcome this shortcoming and includes trade balances (Erb et al. 2009).

Asafu-Adjaye (2005:316) points out that some criticize the NPP concept due to the neglect of the possibility to amend NPP through man-made capital and non-renewable natural resources.

Anyway, this is not really true since NPP acknowledges efficiency gains through management practices (Krausmann et al. 2013). Moreover, in analyzing the reasons for increasing or decreasing HANPP not only management practices are included but also the use of fossil energy-based inputs is acknowledged. Karausmann et al. (2013), for example, illustrate that total HANPP decreased. Analyzing the HANPP components, however, it could be found that the total decrease is, for example, due to the decrease in the usage of fire wood, which was / is substituted by fossil fuel.

Anyway, as Haberl et al. (2012) illustrate, HANPP alone is not a sufficient indicator and should hence be complemented with other socio-economic indicators in order to give a more holistic picture of national and global activities. As already pointed out MEFA, for example, does not capture effects on land use, which is why an indicator like HANPP can prove helpful. Combining different indicators, hence not relying just on a single one like GDP, is one of the scopes of *Ecological Economics* supporting a broader understanding of human nature interactions. This means that not only monetary or biophysical indicators should be complemented, but also, for example, historic or social ones (like happiness or life satisfaction).

14.7.4. Ecological Footprint

Similarly to the MEFA, the EF is based on matter and energy flows and their relation to NPP or the notion of carrying capacity. And similarly to HANPP it measures human use of the environment (Wackernagel et al.1999, Haberl et al. 2004[a]). The EF was introduced by Mathis Wackernagel and William Rees in the 1990s (Asafu-Adjaye 2005:316, Constanza et al. 2009:15).

As stated EF is related to NPP and as already explained above, NPP is an indicator telling how much biomass can be produced on a given territory in a certain period of time. Departing from this assumption, one can calculate whether people's consumption can be satisfied with the resources provided by the territory they live on (Asafu-Adjaye 2005:316, Constanza et al. 2009:15, Wackernagel et al. 1999, Haberl et al. 2004[a]). If demand outpaces territorial supply, resources are imported. Taking this approach it could be shown that most economies overshoot their available resource share and even the planetary resources (Costanza et al. 2009:15, Global Footprint[3], Wackernagel et al. 1999). In effect it is not possible to consume more than is produced on our planet's surface. The current overshoot is financed by old stocks of fossil energy carriers that were built up through the conversion of biomass thousands to millions of years ago, other geological stocks (radioactive metals, ores, rare earths,...) and the unsustainable harvest of biomass stocks, which negatively affects the regenerative capacity of the system (Haberl et al. 2004[a]:282). Hence humanity is not living from the interest but from the savings. A short time overshoot would not necessarily implicate problems. However, the current economic system is built on the idea of

infinite growth, growth beyond the planet's carrying capacity (Wackernagel et al. 1999). Accordingly, we find ourselves in a time where we are faced with the negative results of breaking the chains of biophysical limits.

The *Global Footprint Network* (Global Footprint) provides information about the Ecological Footprint, national as well as global data in an easy understandable way. One very nice example is the story map (Global Footprint[2]), which illustrates global EFs on a country base from 1961 to 2007. It is an interactive tool, which very nicely illustrates global differences and developments over time. Wackernagel et al. (1999) for example present how EF is calculated.

It is argued that the EF methodology is a simple and comprehensive way to account the planet's ecological capacity (Haberl et al. 2004[a]:285f.). Similarly to MEFA, EF is also based on available statistical data, which renders possible comparability and reproduction of the assessments. They point out that in contrast to monetary valuation the concept of EF allows illustration of the biophysical wealth of a territory. Relating the data to territory clearly indicates the finiteness of all resources that humanity is dependent upon (Wackernagel et al. 1999).

The EF can be related to the HDI, thus showing how a high HDI affects the Ecological Footprint of a nation. Figure 19 below indicates that the higher the HDI the higher the EF. Anyway, there are some countries that have a good HDI value and keep within their carrying capacity.

The UNEP GER uses the EF in order to illustrate how the economic impact on the environment changes according to the five scenarios calculated. One of the Green Economy scenarios (G2) is determined through increased investment in a low GHG economy. These investments are reflected in the EF, which is lowest for this scenario (UNEP 20011). However, it has to be pointed out that one of EF's shortcomings is that it does not distinguish sustainable from unsustainable use of resources (Costanza et al. 2009:16). It will be discussed further below, but the G2 scenario, for example, also increases its share of nuclear energy.

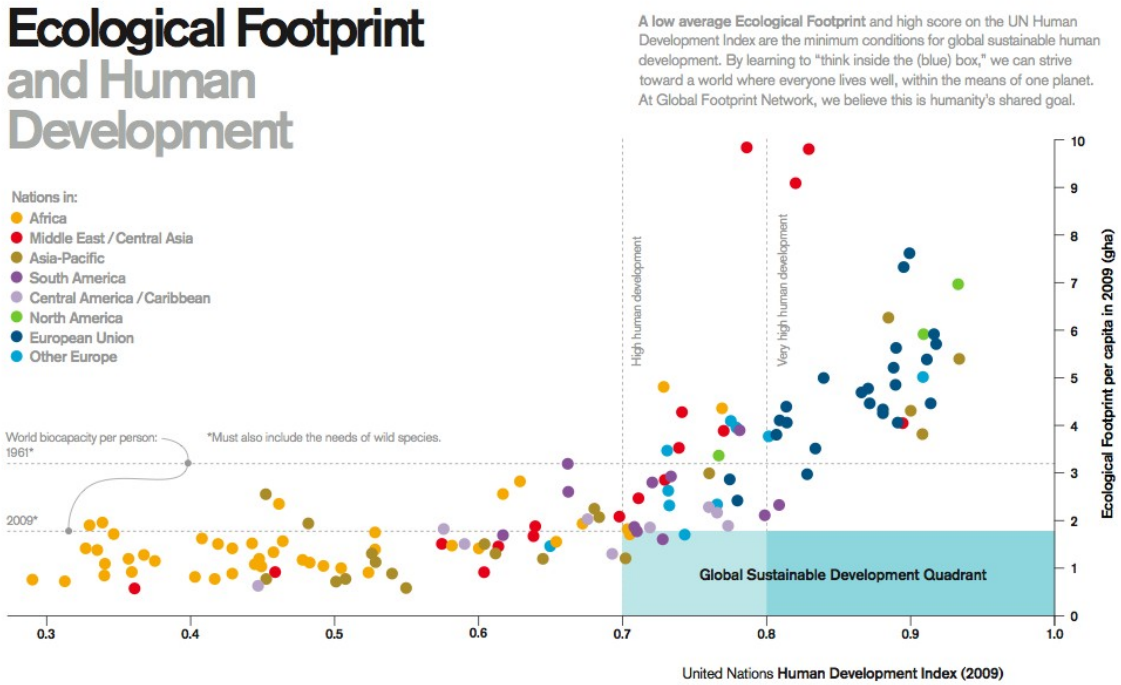


Figure 19: Global Footprint (2012:40f.)

15. Green Economy

Green Economy has been the new hot topic since the financial crisis of 2008 and is attributed to solving our current problems (Wissen 2012, UNEP 2009[1], 2011, UNDESA 2012[1]:8). Many institutions publish reports and papers on this new concept, illustrating exactly how it is supposed to constitute a new economic era. For example, the TEEB initiative introduced above has its own paper on green economy (Ten et al. 2012). In contrast to international endeavors (Green Growth Platform, PAGE) to promote the transition to a green economy, there are also approaches on the community level (Jackson / Victor 2013).

The UNDESA (2012) guidebooks (issues 1 and 2) on Green Economy give an overview of the different understandings, definitions and principles of the concept. They compare the approach of different institutions with the definition of the Rio+20 outcome document (*The Future We Want*) on *Green Economy* and try to find commonalities and differences. They identify 26 different characteristics (principles) which the different institutions assign to Green Economy. In doing so they concluded that the main commonality is that most of them perceive Green Economy as a facilitator for sustainable development, supporting not only the economy-environment interrelation, but also taking the social sphere into account. The Green Economy concept can be therefore seen (and this is stated several times on web pages and in publications) as complementing means to

implement sustainable development, rather than a substitute.

For my analysis I will mainly refer to UNEP's publications, where Green Economy is also perceived as a facilitator of sustainability. “The concept of a green economy does not replace sustainable development; but there is a growing recognition that achieving sustainability rests almost entirely on getting the economy right” (UNEP 2011:17).

UNEP's *Year Book 2008* already indicates a transition to a “new economy”, an “environmentally-sound economy” and a “low carbon economy”. The term Green Economy is not used at that time, but the year book points to the technological inventions that could pave the way for an economic transition, allowing economic growth while at the same time emitting less greenhouse gases and increasing resource efficiency.

> The innovations produced by a decade of experimentation with environmental commodity formation and market design have generated a genuine eagerness for the possibilities of a new economy. That new economy is already in the early stages of formation. Many of the technologies required are already known. A significant proportion of the most successful market players and financial decision makers are demonstrating their commitment to building a new economy, efficiently fuelled by sustainable energy sources. They are increasingly following environmental, social, and governance principles for corporate activities, while investment funds are increasingly investing in accordance with the concept of universal ownership, which views the world economy and environment as interdependent wholes. (UNEP 2008:32)

The *Year Book 2008* (UNEP 2008) focuses on climate change and points out the increasing scarcity of natural resources that has the potential to negatively influence economic activity and thus human welfare. It is attested that already a rising number of governments and enterprises commit themselves to improve their social and environmental friendly performance, a shift which should give further incentives for economic transition.

The term Green Economy first appears in UNEP's *Year Book 2009*. However, the term was not new at that time. The expression Green Economy was first used 1989 in the publication *Blueprint for a Green Economy* and experienced a revival through the crisis in 2008 (UNDESA 2012[1]:7). The concept of Green Economy used in this year book builds on the previous year book but increasingly puts it into relation with sustainability. Within the *Year Book 2008* it is questioned whether sustainability can be achieved with the current economic system or rather with a new one. Interestingly, the conclusion is not written from an *Environmental Economics'* point of view, but from an *Ecological Economics'* one, referring to Robert Costanza and Herman E. Daly. The conclusion of this year book, in contrast to other UNEP publications, does not a mention economic growth as preliminary economic goal. It is acknowledged that in order to reach sustainability a new economic concept is needed that integrates non-market commodities into national accounts, and that builds on the insight that economy is limited by planet's carrying capacity. The following table

(table No. 1) illustrates the confrontation between the current economic system and the proposed Green Economy. Several issues are raised in the conclusion and illustrated in this table, which do not fit to *Environmental Economics*. Hopefully this thesis already helped understanding which features do not fit to the concepts of *Environmental Economics.*

A New Development Model		
	Current Development Model: the "Washington Consensus"	**Sustainable Development Model:** an emerging "Green Consensus"
Primary policy goal	**More**: Economic growth in the conventional sense, as measured by GDP. The assumption is that growth will ultimately allow the solution of all other problems. More is always better.	**Better**: Focus shifts from mere growth to "development" in the sense of improvement in quality of life, recognizing that growth has negative by-products and more is not always better.
Primary measure of progress	GDP.	GPI (or something similar).
Scale/carrying capacity	Not an issue because it is assumed that markets can overcome any resource limits via new technology, and substitutes for resources are always available.	A primary concern as a determinant of ecological sustainability. Natural capital and ecosystem services are not infinitely substitutable, and real limits exist.
Distribution/poverty	Lip service, but relegated to "politics" and a "trickle down" policy: A rising tide lifts all boats.	A primary concern since it directly affects quality of life and social capital and in some real ways is often exacerbated by growth.
Economic efficiency/allocation	The primary concern, but generally including only marketed goods and services (GDP) and institutions.	A primary concern, but including both market and non-market goods and services and effects. Emphasizes the need to incorporate the value of natural and social capital to achieve true allocative efficiency.
Property rights	Emphasis on private property and conventional markets.	Emphasis on a balance of property rights regimes appropriate to the nature and scale of the system, and a linking of rights with responsibilities. A larger role for common property institutions in addition to private and state property.
Role of government	To be minimized and replaced where possible with private and market institutions.	A central role, including new functions as referee, facilitator, and broker in a new suite of common-asset institutions.
Principles of governance	*Laissez-faire* market capitalism.	Lisbon principles of sustainable governance.
Basic characteristics of the current development model and an emerging model based on sustainable "ecological economics."		

Table 1: A New Development Model (Costanza 2008:33, this table was one-to-one transferred to the UNEP Year Book 2009.)

This *Ecological Economics*' perception of Green Economy cannot be found in later UNEP publications and as already pointed out by the UNDESA (2012) guidebooks, most Green Economy concepts still follow the growth paradigm. Moreover, that growth is out of question can be seen through the continuous hope that is put into decoupling (UNEP 2008, 2009, 2010, 2011). Probably economic growth within the Green Economy concept developed new prominence through the multiple crises in 2008.[95] In UNEP's *Year Book 2010,* Green Economy is already presented as a tool that can "hit two birds with one bullet": jump starting economic growth and protecting the environment (see UNEP 2010:14). In 2009 UNEP started its Green Economy initiative (UNDESA 2012[1]), and published the *Global Green New Deal Policy Brief* (GGND) that draws on US President Franklin D. Roosevelt's *New Deal*, which intended to end the *Great Depression* through governmental spending. (UNEP 2009[2]:3) This clearly implicates that promoting further growth is one of the three targets of Green Economy proposed by UNEP from 2009 onward. The GGND policy brief mainly consists of contributions by Professor Edward B. Barbier[96] (UNEP 2009[2]:ii), who is in contrast to Professor Robert Costanza (ecological economist) an environmental economist. Hence the orientation of the GGND differs from the UNEP *Year Book 2009*.

In a publication Costanza and others (Constanza et al. 2013:127f.) point out that Green Economy is a step in the right direction but that it does not go far enough. What is needed is a change in goals and the paradigms which are followed. Such a paradigm shift could have been reached following the earlier direction of UNEP's Green Economy idea, rejecting the unlimited growth paradigm. However, this shift was baffled through the economic crisis starting in 2007 and the fear that without economic growth well-being would be left behind. That Green Economy was previously understood as the paradigm shift Costanza et al. (2013) are talking about can be seen through the comparison of the above table with the table given in Costanza et al. (2013). The table on page 127 was amended with a middle section titled *Green Economy Model*, constituting an intermediary step in direction *Ecological Economics*. Hence, UNEP's Green Economy concept ended up being *Environmental Economics*, rather than *Ecological Economics*.

The major recommendation of the GGND is to stimulate the economy through government spending. In order to reduce environmental degradation investments should target improvements in resource use efficiency, decreasing the dependence on non-renewable energy carriers and

95 Within the (UNDESA 2012[1]) guidebook it is stated that generally through the multiple crises in 2008, the concept of Green Economy became newly relevant. I do not want to contest this but want to add that through the financial crisis that from 2008 on accompanied the unsolved problem of inequality and the ever pressing and more eminent environmental problems, a supposed solution also had to tackle the economic recession.

96 Compare with Barbier (2009).

greenhouse gas emissions. At the same time investments should be inclusive and thus promote the fulfillment of the *Millennium Development Goals* (MDG). Within GGND it is concluded that we experience multiple crises, comprised of water, food, fuel and financial crises, affecting the global inequality, which has one common root cause.

> Although the causes of these crises vary, at a fundamental level they share a common feature: the gross misallocation of capital. In the last two decades, much capital has been poured into property, fossil fuels, and structured financial assets with embedded derivatives, but relatively little has been invested in renewable energy, energy efficiency, public transportation, sustainable agriculture, and land and water conservation. (UNEP 2009[2]:2)

Therefore the GGND can, through proper investments, not only fuel economic prosperity in the short run, but also environmental protection and social justice in the medium and long run (UNEP 2009[2]:3f.). The priority list of GGND is clearly outlined: First aim of the GGND is the recovery of the economy, second is long term sustainability of economic actions and third is poverty eradication. Ranking poverty eradication third is argued through the interrelations between environmental degradation and poverty. Since poor people are assumed depending more on environmental commodities, protecting the environment is of major importance to the poverty eradication strategy (UNEP 2009[2]:5).

BOX 2: Hierarchical ranking of UNEP's Green Economy goals
1. Make a major contribution to reviving the world economy, saving and creating jobs, and protecting vulnerable groups; 2. Reduce carbon dependency and ecosystem degradation, putting economies on a path to clean and stable development; and 3. Further sustainable and inclusive growth, achievement of the MDGs, and end extreme poverty by 2015. Barbier 2009:7, see also UNEP 2009[2]:5

In 2011 a new report by UNEP was published, *Towards a Green Economy Report: Pathways to Sustainable Development and Poverty Eradication* (GER), replicating the above outlined hierarchy. “The key aim for a transition to a green economy is to enable economic growth and investment while increasing environmental quality and social inclusiveness” (UNEP 2011:16). Hence GER builds on the GGND, making the case for a transition toward Green Economy in computing scenarios confronting business as usual (BAU) with Green Economy future scenarios. Again Professor Edward Barbier contributed to the publication. It is a thorough 631 pages report that expands on several key economic sectors, like transportation, energy, agriculture, forestry or fishery. It is explained what UNEP's understanding of Green Economy is, how this is connected to sustainability and how not only the developed but also the developing world can profit from a

transition, which enabling conditions are needed and how the transition can be financed.

For the definition of *Green Economy* GER refers to another UNEP (2010[1]) publication, *Green Economy Developing Countries Success Stories*.

> A Green Economy can be defined as one that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities.
>
> A Green Economy is characterized by substantially increased investments in economic sectors that build on and enhance the earth's natural capital or reduce ecological scarcities and environmental risks. These sectors include renewable energy, low-carbon transport, energy-efficient buildings, clean technologies, improved waste management, improved freshwater provision, sustainable agriculture, forestry, and fisheries. These investments are driven by, or supported by, national policy reforms and the development of international policy and market infrastructure. (UNEP 2010[1]:5)

Through the computed scenarios the UNEP GER emphasizes that Green Economy can facilitate a shift in the right direction. The scenario is called *Threshold 21*, because of the "[...] belief that the 21st century is going to be a threshold period for humankind" (UNEP 2011:509). Five different scenarios are computed using the *System Thinking* approach, taking into account stocks and flows of capital and their interactions through direct links as well as through indirect feedback loops.[97] Concerning the system boundaries, the environment is understood as the system embedding the social as well as the economic system, while the social system also contains the economic one. Between the three systems interactions in both directions are assumed.

The basic scenario is the BAU scenario where things take their course following the current trends, replicating historical data from 1970 to 2009 and extrapolating it for the period 2010 to 2050. Two more reference scenarios are computed, BAU 1 and BAU 2, which illustrate increased investment in sectors that enjoy prioritization in the current economic system. These scenarios are compared with two green scenarios, G1 and G2, where G1 assumes an additional investment of 1% of global GDP equally distributed to key Green Economy economic sectors. The G2 scenario assumes a 2% increase in investment, which is focused on the energy sector and on climate change mitigation. The G2 scenario is seen as being more relevant and is hence the one GER is mostly referring to (UNEP 2011:509ff.).

The data presented in table 7 (UNEP 2001:534ff.), comparing all five scenarios, shows that in the medium and long run the G2 scenarios outperform the BAU 2 (and the other four scenarios) in nearly all indicators (economics, social, environmental). I want to point out two indicators which are important for further analysis in this thesis: population and nuclear energy.

97 For further reading see Meadows (2010) and Meadows et al. (2009).

The highest population number is exhibited in the G2 scenario. Concerning sustainability issues, it is questionable whether it is wise to continue to neglect the population growth issue. Population is mentioned in the report, but policy measures are not suggested. Box 1 (UNEP 2011:15) deals with the population issue, referring to the *8th Principle of the Rio Declaration,* which calls for the "[...] promotion of appropriate demographic policies" (UN 1992). No measures to control population growth are presented in the report; rather, the potential of Green Economy feeding a rising world population is pointed out.

The other indicator concerns energy demand, more precisely the share of nuclear energy demand for the G2 scenario. Table 7 (UNEP 2011:534f.) indicates that the share of nuclear energy is highest for the G2 scenario (see Figures 20 and 21). The share of renewable energy demand in 2050 is also highest in the G2 scenario (27%): However, nuclear energy, even if not being a field of substantial investment in the G2 scenario (UNEP 2011:223ff.), has the highest value. The reason for this seems to derive from the system's framework, aiming at shrinking GHG emissions, but at the same time meeting consumer demand. Nuclear power allows these conditions to be met (Common / Stagl 2005:101). Though keeping the overarching aim of sustainability in mind, it is questionable whether increasing the share of nuclear power is a justifiable trade-off. And from an *Ecological Economics* point of view, nuclear energy is not in line with environmental protection (Costanza et al. 2013:132).

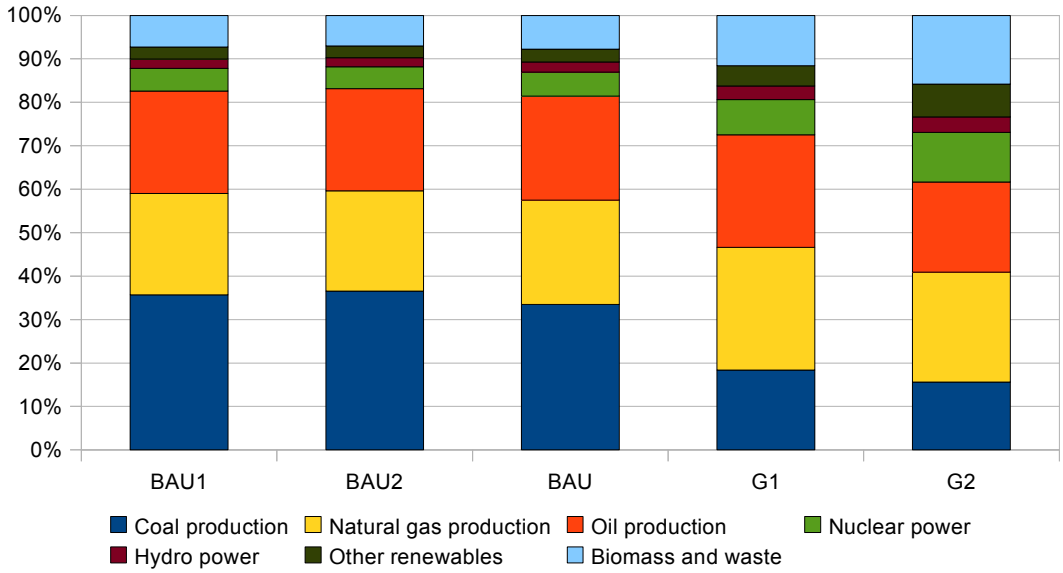


Figure 20: Energy demand 2050 in Mtoe/year source: UNEP 2011:534f.

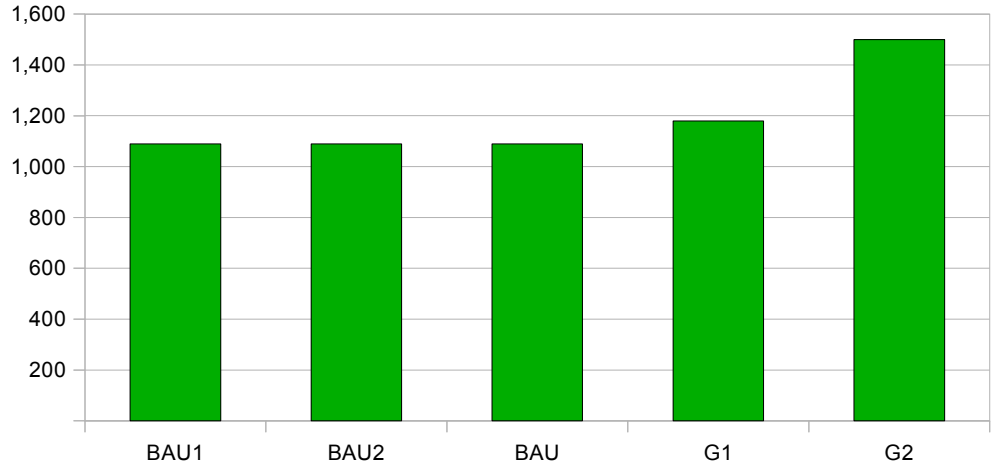


Figure 21: Nuclear energy demand 2050 in Mtoe/year source: UNEP 2011:534f.

The Green Economy concept presented in this report entails an amendment in contrast to the neoliberal economic concept. Figure 22 shows what the preanalytic vision of Green Economy looks like. Compared to the one presented above (see Figure 1), this one includes the environment. This vision again illustrates the acknowledgement of nature as the basis for economic activity and a simple relation between economic activity and resource demand is indicated. The higher the economic growth, the higher the resource demand. Economic growth within this concept of Green Economy is of top priority and is therefore promoted. In order to overcome the vicious circle between growth and resource use, the GER advocates increasing resource use efficiency. Ultimately this should lead to an absolute decoupling, hence a shrinking or at least stable resource use coupled with rising GDP. The importance of decoupling for the Green Economy concept of the UNEP is further highlighted by the work of the *International Resource Panel* (IRP) of the UNEP (IRP) and their reports dealing with decoupling (see for example UNEP:2011[2]).

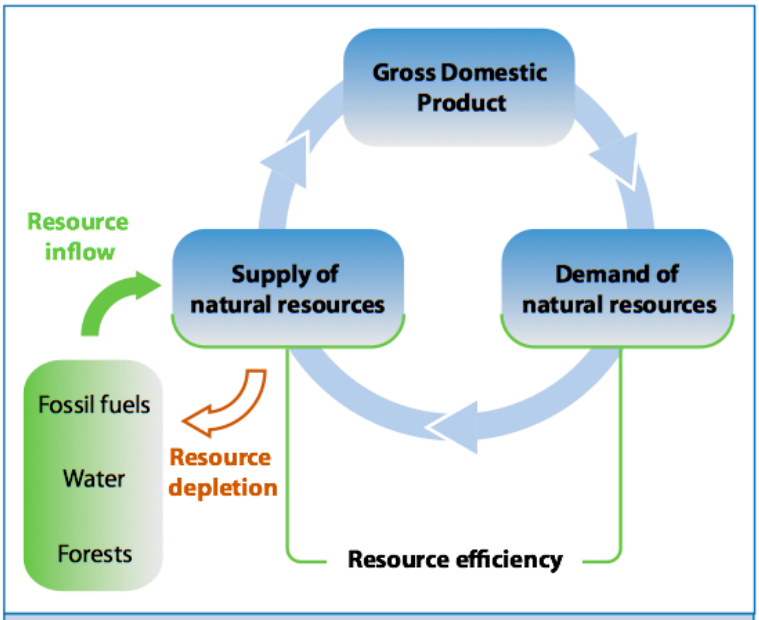


Figure 1: The relations between economic growth and natural resources

Natural resources are both a driver and a possible constraint of economic growth. The higher GDP, the higher demand for natural resources; growing demand leads to higher production, which depletes stocks – all else being equal. Declining stocks, on the other hand, reduce potential medium– to longer–term production of natural resources, potentially constraining economic growth. Resource efficiency is promoted in the GER, to reduce demand and improve the management of supply. The rebound effect is also taken into consideration, as it normally reduces the intended benefits of efficiency improvements by increasing demand.

Figure 22: Relation between economy and environmental system (UNEP 2011:507)

Concluding, it can be said that the Green Economy concept presented in the GER is a step in the right direction, illustrating the potential of shifting investments to the green sector. The GER emphasizes that Green Economy does not mean giving up the prevailing concepts. Green Economy allows us to relieve nature from pressure exerted by human economic actions, while still enabling economic growth and thus the presumed base for human wellbeing. The next part will illustrate some shortcomings of the Green Economy concept presented in the GER.

However, I want to point out that the concept of Green Economy would need some clarification. UNEP's Green Economy concept does not much differ from the Green Growth concept (UNDESA 20121:33ff.). Thus I would agree on Brand's (2012) critique that Green Economy becomes the new oxymoron. Like the sustainability concept, Green Economy becomes an empty shell, where it is not clear what the concept is really comprised of. Hence everyone can fill it with whatever meaning. Similar to the sustainability concept, one could distinguish between two concepts of Green Economy. For some Green Economy does not have anything to do with economic growth and even de-growth is demanded. For others economic growth is key part of it. According to UNDESA (20121:60f.) the main difference is that Green Economy concepts refer to planetary boundaries, while most Green Growth concepts do not. In order to avoid confusion the two existing terms, Green Growth and Green Economy, should be used accordingly (UNDESA 20121:60ff.). From UNDESA's (ebd.) deduction that the difference between the two concepts is negligible, it suggests that the reason for keeping up both terms, without clear distinctive features, is political. Depending on the target group one can choose between one of the two expressions, thus emphasizing different aspects of the concept, making the transition palatable to the audience.

15.1. Decoupling

Applying the logic of thermodynamics it becomes clear that the planetary system is closed, that energy or matter used is only transformed from one state to another. A growing economy, hence a growth in GDP, ultimately means increasing throughput, which in turn means to increase externalities (Pearce 2002:60f.). This fact also became clear to environmental economists (Pearce 2002:60). As already pointed out above economic growth is still the major aim of the economic system, even if now economists and politicians intend to take impacts on the environment into account. In order to break through this vicious circle between GDP growth and increasing throughput, and thus negative externalities, decoupling is a very seductive concept. Decoupling can be differentiated in two categories, relative and absolute decoupling. The latter means that the absolute resource input decreases while GDP rises; hence resource use is decreasing in absolute terms. The former describes the incident that input to produce $1 of GDP declines, while the absolute amount of resource use further increases, but at a slower pace than GDP (Haberl et al. 2004:208). A UNEP (2011[2]) report further distinguishes between the decoupling of resource use from GDP growth and from environmental impact, respectively (see Figure 23).

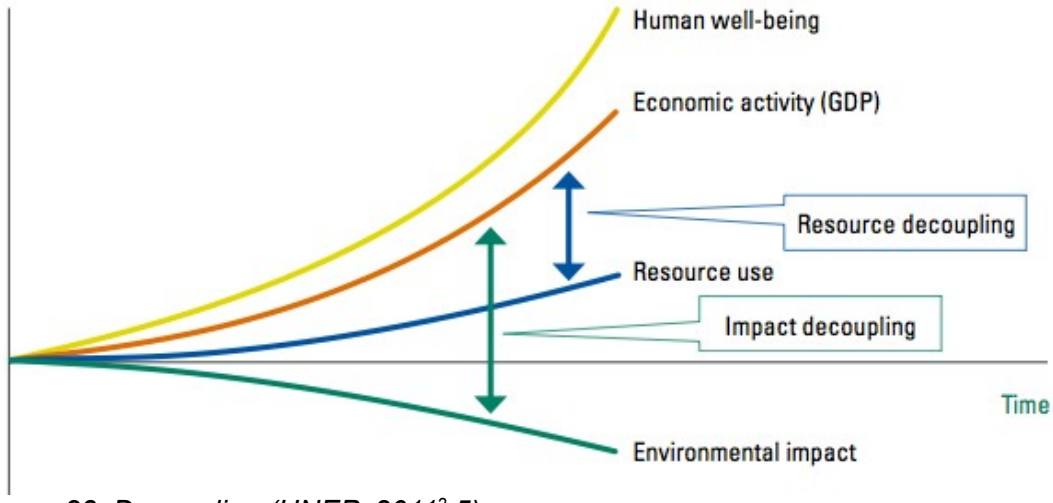


Figure 23: Decoupling (UNEP 2011[2]:5)

The high interest in decoupling becomes clear when reading the UNEP publications, where decoupling is mentioned from the very beginning (UNEP 2008-2011). UNEP's GER (2011) presents five different future scenarios illustrating that decoupling is possible. One aim of the whole report was to illustrate that Green Economy is able to promote or actually fuel economic growth and at the same time reduce its adverse impacts on the environment. As can be seen in the following Figures 24-30, the G2 scenario, which is handled as the most realistic one, if a transition to Green Economy would be pursued, has the best values for all economic indicators (GDP, GDP growth rate, agricultural production, industry production, service production, consumption) while at the same time the Ecological Footprint decreases. Figure 30 shows GDP per capita growth rate together with the Ecological Footprint of scenario G2 compared with BAU2. G2 clearly outperforms BAU2. Not only is BAU2's GDP growth rate much lower in 2050, its environmental impact is also much higher. So the G2 scenario actually leads to decoupling economic growth from its negative impact on the environment. The impressive thing is that decoupling is calculated to occur not only in relative terms, but also in absolute terms, being in 2050 lower than in 2015. Hence although all economic indicators are constantly increasing (population is also calculated to be highest in G2; see *Green Economy*) the impact on the environment is not, and is even decreasing.

These calculations seem to contradict basic physical laws as well as economic equations. The law of thermodynamics says the more we “use” energy or matter the greater the impact on the environment. Similarly, the IPAT equation tells us that the impact on the environment is determined through the population number, the technology employed in production and consumption and

affluence, which are the production and consumption patterns. Considering the IPAT equation for Green Economy G2 scenario the variables for population and affluence increase.

There is one, or one and a half variable, that is supposed to not only offset but even minimize the negative impacts of the other two variables. Technology is believed to do this. A second influencing variable is the behavior. Within the affluence variable two parameters are combined. One is the kind of production and consumption; the other is sufficiency, thus only producing and consuming what is really needed. Within Green Economy the core idea to decrease the impact of economic activities is to shift them to more environmentally friendly ones. So people should consume, for example, a bigger share of renewable energy and thus diminish their Ecological Footprint. Most focus is laid on this part of the affluence variable. The other part is not so much accentuated. Sufficiency is mentioned only once in the UNEP GER. Several times the role of governments to change consumer behavior is mentioned. This however is mostly focused on shifting consumption to green productions, rather than consuming less. And as can be seen in Figure 27, consumption in G2 is highest.

Figure 25: Real GDP US$ bn/year (UNEP 2011:534f., table 7) Figure 26-31 same legend

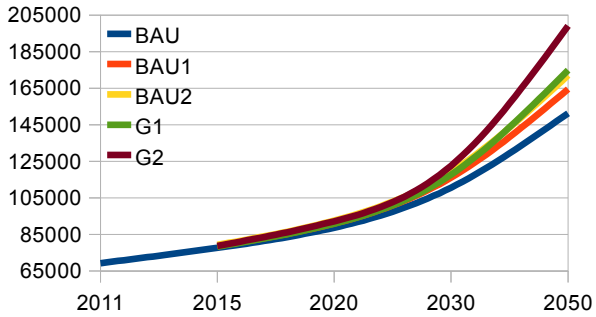


Figure 24: Annual GDP per capita growth rate %/year (UNEP 2011:518, table 4) *there is an error in table 4 the label for the indicator GDP per capita and annual GDP per capita growth rate are interchanged for the years 2020 and 2050.*

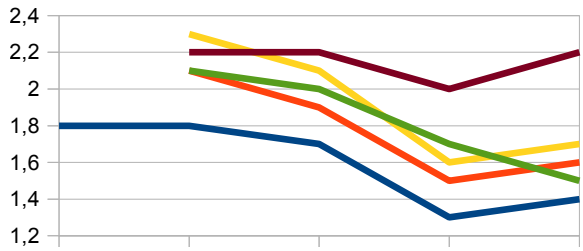


Figure 26: Agricultural Production US$ bn/year(UNEP 2011:534f., table 7)

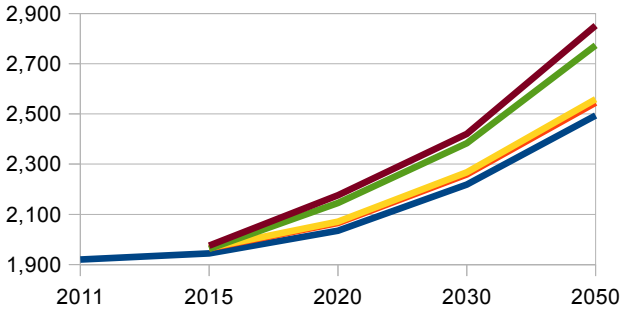


Figure 27: Service Production US$ bn/year (UNEP 2011:534f., table7)

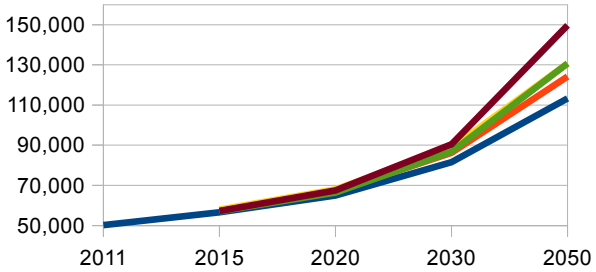


Figure 29: Industry Production US$ bn/year (UNEP 2011:534f., table7)

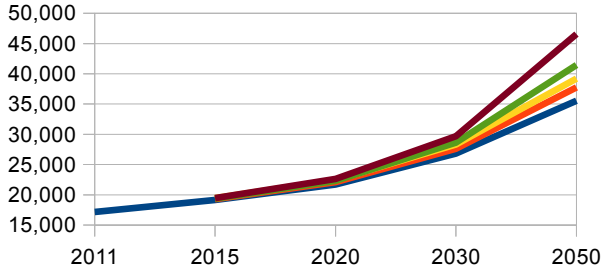
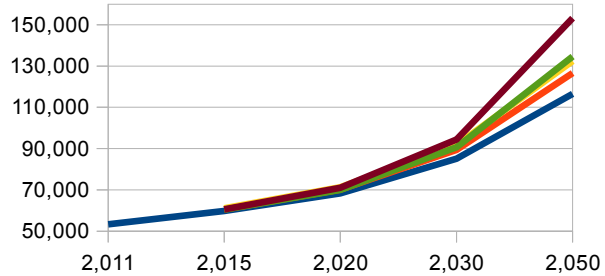


Figure 28: Consumption US$ bn/year (UNEP 2011:534f., table7)



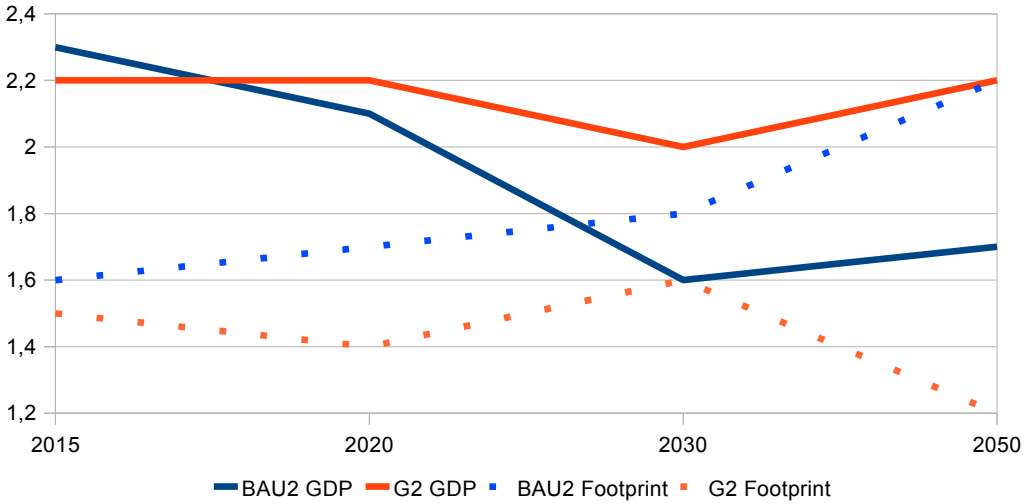


Figure 30: Annual GDP per capita growth rate %/year, Footprint ratio to bio capacity (UNEP 2011:518, table 4, 534f., table7)

So concluding, one can say that much hope and trust is put into technological innovations that should facilitate this enormous decoupling. Of course, the calculations of the scenarios are based on certain assumptions and formulas. One is the *Cobb-Douglas* production function, which was already introduced and on which I will expand below, but first the concept of decoupling will be examined further.

Maurerhofer (2013) analyzes five different decoupling scenarios from an *Ecological Economics* point of view, taking the first and second thermodynamic law and the *Rebound Effect* into account.

	Decoupling scenarios				
	A	B	C	D	E
Growth	Increase	Increase	Increase	Equilibrium	Decrease
Resource use/ environmental degradation	Smaller increase	Equilibrium	Decrease	Decrease	Larger decrease

Figure 31: Decoupling scenarios (Maurerhofer 2013:47)

The five scenarios can be further categorized into growth and de-growth scenarios. As can be seen in Figure 31, scenario A means that economy grows as well as the resource use, but the latter at a smaller rate than the former. This is relative decoupling, which implies that the absolute resource use increases, in relative terms; however, the resource growth is decoupled from economic growth. As Maurerhofer points out, given that we are already in a situation that forces us (in case that we want to halt losses in biodiversity and non-renewable energy or other non-renewable resources, like soils) to diminish or at least keep our resource use stable in absolute terms, scenario A is not an option. Concerning B and C, Maurerhofer challenges the likeliness and feasibility of these scenarios. It is questionable if, with increasing economic growth, resource use can be kept stable or even decreasing in absolute terms. Apart from the necessity for new technologies to implement such a scenario, the author indicates the dampening or even reversing effects through the *Rebound Effect*, or the problem that according to the second thermodynamic law, recycling will not solve all our problems (although it is indeed a step in the right direction [Haberl et al. 2004:206f.]). Wissen (2012) also refers to the *Rebound Effect* and adds that decoupling as such will not solve the problem since the social disparities that were born out of the neoliberal system are not changed. It is an already old finding that economic growth, growth in GDP, is linked to increasing resource use (see Klitgaard / Krall 2012:247, UNEP 2011[2]:14f.). As long as this is the case, and there is no technology that seems to promise a different relation, decoupling with economic growth will not work (at least not to the extent that would be needed to save the planet).

Mauerhofer presents two more scenarios that are characterized by stagnating, diminishing economic growth, respectively, and decreasing resource use. Under de-growth scenarios, decreasing resource use seems to be more likely (taking population growth into account, still absolute decreasing resource use is questionable, as the IPAT equation indicates). A stagnating or even shrinking economy is inconceivable within the neoliberal (*Environmental Economics*) logic. Growth is regarded as the ultimate panacea to poverty and environmental problems. The *Kuznets Curve* and its adaption to environmental problems, the *Environmental Kuznets Curve,*[98] respectively illustrate how neoliberal economists think growth will solve the problem (Common / Stagl 2005:247ff.). Moreover the unbowed belief in technological progress, which should facilitate ever-increasing efficiency, and thus declining resource use, legitimize the pursuit for economic growth even with the evidence of social and ecological trade-offs.

Historic data illustrate that so far we could realize relative decoupling (see Figure 33). Comparing this figure with the ones describing the performance of the Green Economy scenarios, it is indeed questioning how absolute decoupling will be achieved? A study on the resource use in the European Union from 1980 to 2000 (EUROSTAT 2000:41), using DMC data, shows that relative decoupling was possible over this period. When disaggregating the aggregate value it was found that some countries even exhibited a moderate absolute decoupling, while some only reached relative and others did not achieve any decoupling at all. It is concluded that absolute decoupling is connected to economic downturn and that no clear pattern or trend can be deduced from the data (EUROSTAT 2002:14). Similarly Dittrich et al. (2012:33) could find national absolute decoupling. However, they also point out that absolute decoupling was only possible for countries with weak economic growth. Moreover, it is emphasized that DMC data does not reveal trade or outsourcing activities. Hence absolute decoupling can be achieved by sourcing out resource-intensive production (see also UNEP 2011[2]). The UNEP decoupling (2011[2]) report also illustrates that material use grew in the last century and that no substantial diminution is found. They also point to the phases of lower material extraction during phases of economic stagnation. Moreover, it is indicated that in the 20th century metabolic rate increased twice as fast as population growth but slower than GDP growth rates. This implicates some relative decoupling. However, it is not clear what exactly led to this decoupling. Anyway, their analysis shows that substantial changes are needed in order to achieve absolute decoupling. Apart from population control, policies concerning affluence and improvements in technology, a different understanding of wellbeing will be helpful. Thus wellbeing should not be confused or equated with GDP growth. Hence other indicators are necessary.

98 References that illustrate that it is not the effect of rising income that leads to environmental protection: Magnani, Elisabetta (2001), Torras and Boyce (1998).

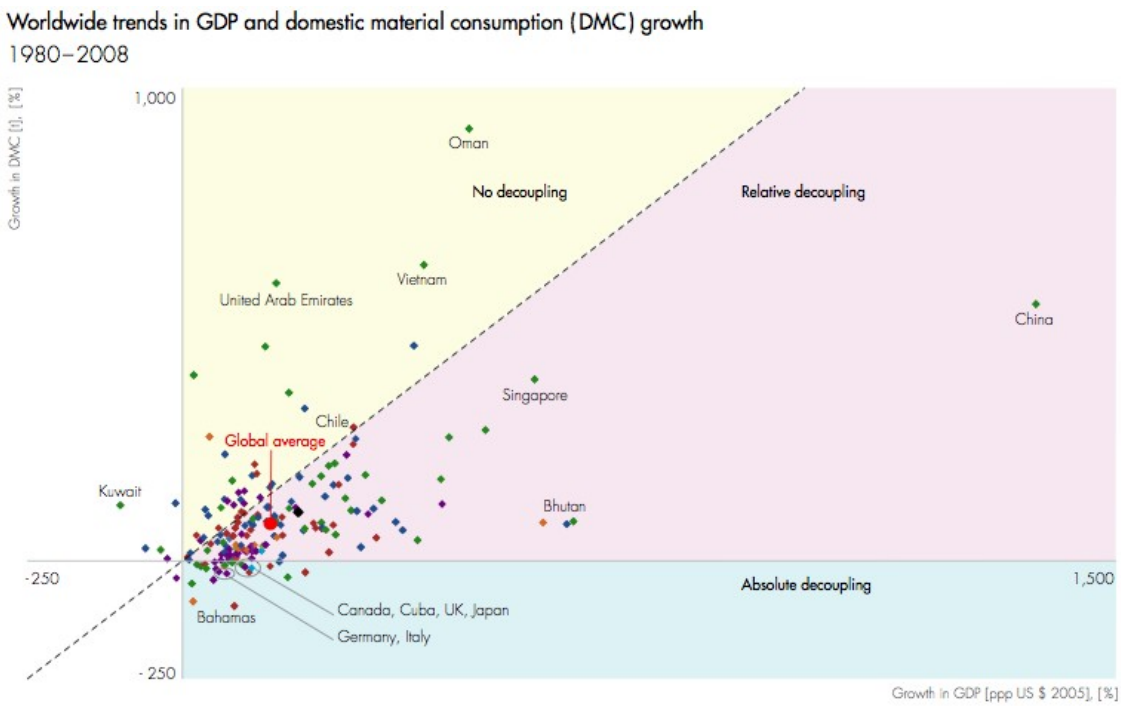


Figure 32: Decoupling illustrated with the ration of GDP and DMC (orange: Australia and Oceania, light blue: North America, purple: Europe, green Asia, dark red: Latin America, dark blue: Africa) (Dittrich et. al 2012:33).

The Friends of the Earth report (2009) furthermore points out that resource intensity differs from region to region. Regions where extractive activities are dominant have a higher resource intensity, which is due to the implicit high resource inputs for extraction. Thinking about diminishing natural resources and the increasingly costly exploitation again raises the question whether absolute decoupling will be possible. Tar sands or deep water drilling make exploitation more resource intense, not less. Even if we neglect fossil fuels, there are many other resources needed, like rare earths, which will get scarcer and thus will make exploitation more resource intensive (see also UNEP:2011[2]).

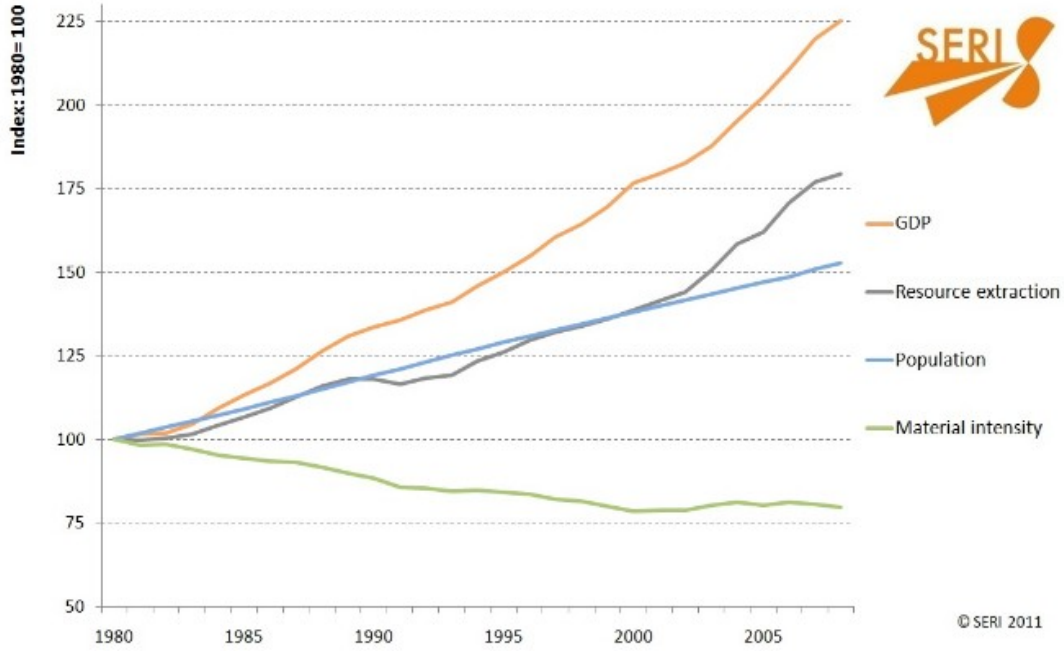


Figure 33: Trend of GDP, resource extraction, population and material intensity. (SERI or Dittrich et. al 2012:33)

To conclude, as Krausmann et al. (2009, Dittrich et al. 2012:18) show, absolute decoupling could not be observed throughout the history. The only occasions when resource use in absolute terms declined or stagnated were during times of economic downturn or stagnation. Hence so far lower resource consumption could be achieved when GDP decreased (see also Behrens et. a. 2007:445), something which is not desired in orthodox economy.

Ecological Economics does not completely deny the possibilities of decoupling and indeed it is acknowledged that considerable savings can be achieved (Haberl et al. 2004:209). However, considering the biophysical reality, absolute decoupling so far seems to be impossible and thus the issue of decoupling and technological innovation is not of top priority. “But the notion that we can save the ‘growth forever’ paradigm by dematerializing the economy, or “decoupling” it from resources, or substituting information for resource, is fantasy” (Daly 1996:28).

However, the notion of decoupling can and should be promoted, but from a different viewpoint. Haberl et al. (2004:208) explain that one can distinguish three different types of decoupling:

1. Decouple economic performance from material consumption
2. Decouple wellbeing from material consumption
3. Decouple wellbeing from economic performance

The first one was just discussed and seems to be rather unrealistic (in absolute terms). Anyway, the second and third options were also already discussed (sufficiency and steady state economy) and seem to be more realistic. Again, it is not about depriving poor people of their right to fulfill their basic human needs or to live a decent life. Rather, it is the rich people that have to change their attitude and experience wellbeing and happiness through other means than just consumption. The third point is about the steady state idea, which implies further development instead of growth. Haberl et al. (2004:208) relate the third point with the notion of equity. I would suggest that this is a part of the steady state economy, which also includes the redistribution wealth instead of everyone growing rich (see Daly 1996).

15.2. Cobb-Douglas production function as a magic formula

Above it was explained that absolute decoupling as indicated in UNEP's GER G2 scenario seems to be unrealistic, at least under the technological conditions and possibilities we have to date. And again, considering thermodynamics it is questionable how absolute decoupling should work, since this would mean to invent a perpetual mobile, which was not possible so far. Apart from that, absolute decoupling was only possible in times of economic downturn, which is not desired and which G2 clearly does not exhibit. So how does such a result happen to be?

The *Cobb-Douglas* production function was also used in UNEP's GER calculations. Hence one can assume that this function had an effect on the results. The function was briefly introduced previously. To recap, the function entails factors of production which make up income. As assumed in orthodox economics production factors, labor, technology and resources, are seen as nearly complete substitutes. Daly (1996) criticizes that the *Cobb-Douglas* production function allows resource use to approach zero, with constant yield and increasing input of the factor labor or capital. “Resources are seen as “necessary” for production, but the amount required can be as little as one likes” (Daly 1996:48).

Common and Stagl (2005:218) also criticize the usage of the *Cobb-Douglas* function and clearly illustrate why. In their handbook they show the relation between economic growth and resource use, engaging the *Cobb-Douglas* and the *Leontief* production functions. The former allows substitution of production factors; the latter does not. Already from this simple difference they conclude that “[n]ot surprisingly, it turns out that relationships between economic growth and environment differ according to which of these is used in the model” (Common / Stagl 2005:221).

For renewable resource extraction using the *Leontief* production function, the sustainable harvest is limited by the resource's regenerative capacity and the population. If maximum sustainable yield is reached, rising population numbers must result in declining income per capita. Using the *Cobb-Douglas* production function, however, allows – with assumed technological progress and increasing efficiency – infinite economic growth. The situation is a bit different for non-renewable resources. However, using a *Cobb-Douglas* production function still allows us to postpone declining per capita yield compared to the peak using a *Leontief* production function.

The important point is that the function used influences the result. In this case the *Cobb-Douglas* production function allows nearly perfect substitution, which is in many cases not very likely. Besides, substituting one input with another one does not necessarily mean to decrease environmental impact. Many conditions need to be fulfilled in order to allow technological innovation and efficiency to grow at a sufficient pace. One is investment, which needs precedent savings. Victor and Jackson (2012) point out that although increased spending of 1 to 2% of GDP is assumed, the UNEP GER does not indicate where the money comes from. GDP is highest in the G2 scenario; therefore this scenario has also the most financial means for transition. Again the report keeps quiet on where the additional 2% of global GDP per year comes from. Victor and Jackson (2012:13) state, “This strikes us as an unfair comparison of the two scenarios, since investment is one of the main drivers of economic growth. The comparison would have been more balanced if the absolute levels of additional investment were the same, not the percentages.”

So from what was explained so far it seems to be unrealistic to reach such good scenario results, assuming GDP, population number and affluence to be highest. The only means to mitigate the adverse environmental effects of economic growth can be offset by technological innovation and increasing efficiency. The *Cobb-Douglas* production function just seems to fit perfectly to conceal the impossibility of such a goal. UNEP's GER does not tell much about the calculations, apart from stating which formula was used and that investment, technological innovation and increasing efficiency are key.

Mr. Bassi,[99] coordinating author of the chapter *Modelling global green investment scenarios: Supporting the transition to a global green economy,* was very helpful in shedding some light on the issue. For three sectors the *Cobb-Douglas* production function was employed, namely agriculture production, industry production and service production. Other sectors like fishery or

99 Additional information was given through e-mail correspondence by Mr. Andrea Bassi.

forestry are not based on *Cobb-Douglas* production function. For the sectors where *Cobb-Douglas* production function was used, investment in technological innovation and increasing efficiency is key. Increased efficiency leads to lower consumption (due to less resource input, not due to sufficiency). Increasing efficiency also results in increasing savings, which again flow in the model as additional savings and / or consumption.

It has to be stated that although the *Cobb-Douglas* production function was employed through the total factor productivity (TFP) the production function could be influenced by environmental circumstances. This means that productivity is not only influenced by technological innovation but also through the state of resource stocks. A declining resource stock can thus have negative effects on the production. Hence a feedback loop was installed in the function to link the state of the environment to the economic performance (Bassi 2011). This is a reason why the brown scenarios performed worse than the green scenarios (apart from different amounts of investment).

Although this is a quite realistic adaption of the *Cobb-Douglas* production function, the question remains how the additional investment will be gained. One might just think about the climate negotiations (The Guardian). It is already a hard if not nearly impossible goal to shift money from brown to green sectors. The climate negotiations are blocked by economic considerations and the fear of losing economic power to developing or transitioning countries. The issue of inequality is indeed also relevant for the Green Economy debate (Victor / Jackson 2012). Moreover, it would be interesting calculating the scenarios employing another production function which is much more rigid in terms of input substitution.

UNEP's GER made a step in the right direction. The interrelation between environment and economy is clearly acknowledged. However, the infinite growth remains intact. The reality which is calculated by the scenarios is convincing. No one has to abdicate anything and the environment can still be saved. But as explained, the biophysical reality and historic data tell a different story. It is a fact that I can calculate whatever sophisticated models and pretend that this is based on real assumptions. If the underlying assumptions of my model are not correct, neither are the calculations.

The report is a good example illustrating the major differences between *Ecological* and *Environmental Economics*, where the latter fully complies with this idea of green economy, while

the former would not. In the following section the major differences between the two schools of thought will be outlined.

16. Differences and Similarities between Environmental Economics and Ecological Economics

Finally this section will briefly outline the differences between *Environmental* and *Ecological Economics*. Table 2 gives a quick overview. However, there are many more differences than could have been discussed in this thesis. Another topic not touched, for example, would be money, which is discussed by Daly (1996) or Costanza et al. (2013). Moreover, the topics covered could indeed be discussed more thoroughly, like human behavior or ethics. However, the main issues are covered in this work and will be summarized below.

One difference can already be found in the institutionalization of the two schools of thought. *Environmental Economics* is institutionalized (for example) in the *European Association for Environmental and Resource Economics* (EAERE) (Illge / Schwarze 2009:595). *Ecological Economics* is organized in different institutions (e.g., *European Society for Ecological Economics* [ESEE]), has different journals and has as well different representations in Universities. Illge and Schwarze (2009:595) point out that this has positive as well as negative implications. On the one hand, this helps *Ecological Economics* to find its own way; on the other hand, it prevents or impedes finding synergies. However, *Ecological Economics* is also more interdisciplinary, being not only focused on economics and trying to combine different disciplines.

The mono- and interdisciplinarity of the two schools of thought can also be discovered though environmental and ecological economists' self-perception. Borgström-Hansson (2003:91f.) found that environmental economists emphasize their footing and affiliation with economics. This is different from ecological economists' self-perception. Moreover, environmental economists also criticize ecological economists' lack of economic formation.

Environmental economists (2003:92) also point out their rationality, which allows them to analyze real problems and find solutions. It is moreover perceived by environmental economists that their rationality allows them to cooperate with all stakeholders.

But let us start from the base, which results in and explains the major differences: the preanalytic vision (Müller 2001, Daly 1996). It was stated that orthodox economy is only focused on economy,

excluding everything else. This leads to a preanalytic vision, which is limited to an isolated economic circle only comprised of companies, households and the exchange of money and commodities between them. *Environmental Economics* somehow does extend this vision, also taking into account the environment. But the hierarchy of ordering seems to be upside down as compared with *Ecological Economics,* where the economy is a subsystem of the environment. Although *environmental economists argu*e that they do not intend to produce this kind of ranking, it is automatically implied. As Daly (1996) argued, the economic system is amended until everything is included in the economic system. *Ecological Economics* start from a different point of view. Not the economic system is the starting point of analysis, but rather the environment. Economy is understood as a system interwoven in the environmental system (Bergh 2001:15).

So *Environmental Economics* tries to adapt the environment in a way that fits in the concept of economic theory. The tool for this "integration policy" is internalization in all its variations outlined above. There is a deep belief that the economic system does not need to be changed. The market system is believed to be able to give the right signals in order to direct consumption and production in an environmentally friendly direction. This is in deep contrast to *Ecological Economics*. Although this school of thought does not deny the usefulness of some internalization tools, there is no trust in the market system as such. Ecological economists follow biophysical laws and reality, rather than economic ideas. From biophysical laws, like the thermodynamic laws and the implicit absolute scarcity of everything, considerations start from a completely different angle. Moreover, risks like irreversibility or ethical considerations like intrinsic value further direct the work of *Ecological Economics* (Bergh 2001:15).

The bases of both schools of thought differ, as can be illustrated through the different preanalytical visions. *Environmental Economics* extends the neoliberal logic to environmental problems. Therefore individualism, rationality, marginalism, efficiency and general equilibrium models form the base of analysis. Environmental economists believe that the environment makes up part of the economic system, and thus economic methods can be used to solve problems regarding the environment (using the utility approach) and making the market for environmental goods and services tractable. *Ecological Economics* considers more the biophysical sphere as influencing factor and thus includes analysis concerning thermodynamics as well as ecological modeling. They generally doubt the tractability of the environment through market means (Venkatachalam 2007:551, Müller 2001).

Ecological economists, in contrast to environmental economists, perceive the environment as a superior system to the economic system. The system and its interactions as a whole are much

more complex than perceived by environmental economists. Ecological economists therefore think that the neoclassic methods will only be able to address and solve some of the present environmental problems. The inability of neoclassical methods to solve environmental problems results from neoclassical theory ignoring the limits to growth, the interdependence of the human-nature system and the neglect of the role of time. To capture the complexity of problems, ecological economists employ various methods: footprint, macroeconomic scale, long-term sustainability. This plurality is also an alternative to the one-dimensional, abstract model of neoliberal understanding, providing a multitude of models that aim at reflecting and capturing reality (Venkatachalam 2007:551, Müller 2001).

Since *Ecological Economics* is interdisciplinary, it does not focus on one single unit of measurement, but rather on different ones. This is why besides monetary values, also physical but also qualitative units are employed. The problem of value incommensurability is also acknowledged and expressed in the development and usage of SMCE. In contrast *Environmental Economics* merely relies on monetary units and believes in the commensurability of values. Thus absolute substitution is taken for granted and ethical considerations do not really have a stake. Believing in commensurability of values and in absolute substitutability CBA is the tool of choice to analyze different investment options (Bergh 2001:15, Müller 2001).

Another difference is the role of scale and allocation. For *Environmental Economics* scale is not an issue, since it is believed that the optimal scale is found automatically through the market mechanism. However, as one of the intellectual fathers of *Ecological Economics*, Daly (1996) pointed out that this is a flaw. He rather proposes that first scale, then distribution and only at last allocation has to be considered. This again is explained by the rooting in biophysical considerations, like carrying capacity. *Ecological Economics'* understanding that there are absolute limits recognizes that one cannot allocate what is not there. Accordingly, first one has to assure that humans do not overexploit the resources on which human life is based on. This is why the absolute resource use has to be focused on (Rees 2001:10, Bergh 2001:15).

Distribution is, of course, an issue covered by both schools of thought. Anyway, how a fair distribution can be gained is understood differently. Since *Ecological Economics* basically believes in the market mechanisms, besides marginal governmental intervention (e.g., taxes) not much has to be done to facilitate fair distribution. For *Ecological Economics* distribution is much more important. There is no belief in a trickle-down theory or the *Kuznets' Curve* that automatically leads to a fair distribution. Rather, real redistribution policies are promoted. This applies to intra- as well as intergenerational distribution. So governments should not only serve promoting a fair distribution

for the current but also for future generations (Müller 2001).

Also, the goals and criteria to evaluate development and policies differ. For *Environmental Economics* it is efficiency that matters. There are no ethical implications that influence the efficiency imperative, even if it leads to a “more is always better” attitude. The only ethical consideration evolving from the efficiency notion is that not directing actions toward efficiency is unethical, since this would lead to waste of resources. It is assumed that distribution and equity are rendered possible through the market mechanism. In contrast, *Ecological Economy* does emphasize distributional issues much more (inter- and intragenerational). Therefore the inequality within countries, but also between North and South, is much more a core issue that is also seen in connection with environmental degradation (Müller 2001:434). Bergh (2001:15) adds that some economists believe that it is impossible to measure allocation separately from distribution, and that accordingly the tool of allocation alone is not an adequate indicator to measure efficiency.

Environmental Economics is directed to welfare and utility, which is measured through CBA. So the change that happens to the environment is valued through the human transmitter that experiences an increase or decrease of utility / welfare through that change. Hence the value of the ecosystem is encoded in the value humans feel. This is completely contrary to *Ecological Economics*, where the human perception is not the focus. *Ecological Economics* is focused on the ecosystem apart from human perception; the functioning of the system is not related to humans’ subjective perceptions, but to objective biophysical indicators that try to capture the state of the ecosystem apart from human perception. Therefore the concept of ecosystem health is used to express factors like resilience, productivity, stability, biodiversity, and quality (Bergh 2001:16).

Venkatachalam (2007:556) points out that *Environmental Economics* is through its rigorous methods more effective in influencing policy makers. In contrast *Ecological Economics* is a very broad field, offering a multitude of approaches. This, however, makes it hard to present the concept as a closed body of research with clear recommendations for policy makers. “The ecological economics has not yet provided any concrete and widely accepted theoretical framework to deal with the ecological issues” (Venkatachalam 2007:556, see also Müller 2001:439, Borgström Hansson 2003:172f.). I would contest this statement. *Ecological Economics* has a clear understanding of tackling environmental but also social problems. Daly (1996) alone gives several policy recommendations, but also more recent publications do so (see e.g. Costanza et al. 2013). It is not that *Ecological Economics* does not offer solutions; the problem rather is that they are not accepted by mainstream economists and policy-makers, since they largely reject the current economic paradigm of unlimited economic growth.

Like Venkatachalam, Bergh (2001:16) also points out that behavioral economics could give important and enlightening insights and amendments into the current economic theory. According to Bergh, *Ecological Economics* criticizes concepts within neoliberal economy like (unbounded) rationality, utility fixation, and profit maximization. Exactly concerning these concepts other economic schools of thought are challenging their validity. Evolutionary economics, institutional economics, experimental economics, psychology and sociology can give useful insights to behavioral issues. However, Bergh points out that *Ecological Economics* so far could not generate and offer many alternatives.

Last but not least, one major difference is their perception concerning sustainability. *Environmental Economics* follows the weak sustainability concept, while *Ecological Economics* follows the strong one. The reason for this is again found in the preanalytic vision, hence the acknowledgement that different kinds of capital are substitutes or complements. For *Environmental Economics* capital or production factors are substitutes and sustainability is believed to be guaranteed as long as the overall level of capital keeps stable. The share of the different types of capital can vary. So when natural capital is sacrificed for built capital, financial capital, for example, has to increase. This is completely different from *Ecological Economics*, where not only the overall level of capital matters but also the share of capital types. The goal is to keep the different capital types within an equilibrium.

	Classical / strong Sustainability / Ecological Economics	**Neoclassical / weak sustainability / Environmental Economics**
Preanalytic vision	Holistic, open, economy is a subsystem of the environment	Circular, isolated system, semi-detached from the environment without environmental system
Paradigm	Qualitative adaption → Development	Quantitative adaption → Growth
Imperative	(Environmental) ethics	Utilitarianism and functionalism
Economic prioritization	Scale – distribution – allocation	Allocation – distribution – scale
	In a full world natural capital is the limiting factor, rather than man-made capital	Manmade capital is the limiting factor and needs to be maximized
	Strong sustainability	Efficiency
Development strategy	Growth for developing economies and development for mature economies	Growth for all
	Redistribution of wealth → steady state	Growth → trickle down, KC Market mechanism → Pareto efficiency
	Co-evolution, diversity, non-linearity	Linear development model
I=PAT focus	All three together	Technology
Population	Population control	Automatic reduction → development

		path
Affluence	Sufficiency and changed consumption and production patterns (particularly in developed countries)	Changed consumption and production patterns → green growth concept
Added value	Value is added through nature and through humans	Value is only added through humans
Valuation	Nature has value for its own, apart from an anthropocentric point of view. Additionally nature has value for humans	Nature only has value for humans
	Values are inherent	Pretends to be value free
	Incommensurability	Commensurability
Substitution	Limited substitution → strong sustainability concept	Complete substitution → weak sustainability concept
	Natural and manmade capital are complements	Natural and manmade capital are substitutes
Environmental protection strategies	Focus on direct environmental protection → governmental intervention	Focus on indirect environmental protection → market mechanism → Growth → EKC
	Absolute reduction of resource use as solution to environmental problems	Internalization, market mechanisms, and right prices
Time horizon	Long-term focus	Short-term focus
Analytical tools	SMCE	CBA
Measurement	Biophysical units, monetary valuation and qualitative indicators	Monetary valuation
Research approach	Interdisciplinary and transdisciplinary	Monodisciplinary

*Table 2: Differences between Environmental and Ecological Economics (*Source: Bergh 2001:16, Munda 1997:228 and own analysis)

From the analysis above it is clear that *Environmental* and *Ecological Economics* are two economic schools of thought that indeed have some commonalities, but the disparities separating them seem to be insurmountable. The root cause is the different preanalytic vision and the conclusions that follow from them. In simple words it is the unlimited growth versus limits to growth paradigm (Müller 2001:438). These are two completely contradicting ideas, which cannot be united. The only bridge I could find is the aim to protect the environment, although the impulse for that goal differs. Both employ one common tool: monetary valuation.

It was pointed out that *Ecological Economics* also employs monetary valuation methods. *Environmental Economics* uses monetary valuation in order to internalize environmental externalities. To be part of the market system a commodity not only needs to be perceived useful and relatively scarce; in the following it also needs a price. The reason for *Ecological Economics* to

use environmental valuation is a bit different. For *Ecological Economics* it is rather a tool of communication (Borgström Hansson 2003:165, Gómez-Baggethun et al. 2010). Attaching a value on a ecosystem, for example, is for many people the only means to grasp the value of it. Thus *Ecological Economics* does not mainly focus on making trade-offs between environmental protection and business, but to illustrate the incredible high value of nature (see, e.g., Costanza et al. 1997). “Even without any subsequent valuation, explicitly listing the services derived from an ecosystem can help ensure appropriate recognition of their importance. This can help make the analysis of ecological systems more transparent and can help decision makers weigh up the relative merits of the different options before them” (Costanza et al. 2011:2).

I want to base the notion of monetary valuation as means of communication on Luhmann's (Lee 2000, Schwanitz 1995) system theory and combine it with the concept of coevolution (Kallis 2007) and with the socio-ecological idea of human-nature interactions (Haberl et al. 2004). According to Luhmann, social systems are constructed through communication, rather than through the individuals. It is also communication that helps social systems to evolve and further develop. There is, however, not only one social system but many, one of which is the economic system, and the means of communication is money. When we go to the grocery store prices tell us the value of a commodity. And our reaction to the price code is again communication, the preference-steered decision to take it or leave it. Price is the transmitter through which communication in the economic system works.

The structure of the system, what it is comprised of, is determined by the system itself and the differentiation from other systems and the environment. The borders of the economic system are thus given through the items it communicates about. Hence commodities traded on the market are part of the economic system, commodities which are not traded and which do not have a price code are not part of it. Systems need to communicate and to react to events in order to stay relevant. Such events are, for example, environmental problems, population pressure and so on. The economic system can now decide to react to such events in one way or another, which in turn can lead to the evolution of the economic system. A further development would, for example, be to put a price code on items that had no price before.

The communication code of a social system can only be understood by entities being part of the respective system. Someone not being part of the economic system will not understand the price communicator. Indeed, nowadays there is hardly anyone not understanding it, since nearly all exchanges of commodities are operated through the economic system. However, the extension of the price code to environmental goods is something relatively new, which might be the reason why

many people are reluctant or unwilling to use the price code for such items. For others, however, who are mainly part of the economic system, the price code is the most understandable one. Other codes that express appreciation of environmental items used by other social systems are not accessible for these people.

Ecological Economics does not only use the price code, but also other codes that communicate features of environmental items. This is the use of biophysical codes, but also of qualitative codes. In employing more than just one code it also combines the language of different social systems, which is called interdisciplinarity. This is probably the reason the results of *Ecological Economics* are better understood by a greater populace. They simply use codes understood by individuals. However, the problem from a political point of view is that the economic code is the one which is most accepted; thus, it is the most influential one. I believe this is one major reason why ecological economists also use the price code for communication (Gómez-Baggethun et al. 2010, Gómez-Baggethun / Ruiz-Pérez 2011).

For Luhmann communication is a facilitator of evolution. I now want to expand this and use the term coevolution, which basically means that two systems influence each other, which in turn results in the evolution of both systems. This can be observed for the natural and economic systems. The economic system uses its means of communication to give information about the value of items. But also the state of items is communicated by it, like its scarcity. Human actions changed the environment of the economic system, and these events result in an amendment of the economics system, which is to integrate environmental items in the communication. This amendment has effects on the behavior of the individuals receiving the new message. This in turn may have an effect on the environment again. Thus changes in the environment lead to changes in the economic system, which leads to changes in the environment. Gómez-Baggethun et al. (2010, see also Gómez-Baggethun / Ruiz-Pérez 2011):) also point out that ecosystem service science originally aimed at merely communicating the value of ecosystems to humans.

To better understand the coevolutionary process I would like to relate this to the human-nature perception of social ecology. Taking a social ecology point of view, the economic system is understood as the intersection between environment and culture. Economy is the exchange of commodities, while the economic system alone does not work. One needs the environmental system and the cultural system. The environmental system provides the commodities, while the cultural system provides meaning. The information exchanged through trade can affect the cultural system, which comprises human cognition.

Social Ecology is in line with the principles of *Ecological Economics*, where economy is understood as part of the social system, which in turn is part of the environment (Costanza et al. 2013:128). The only difference is that Social Ecology perceives the social system also as an independent system. The independent system is the world of ideas, so the cognitive and cultural sphere. Indeed this sphere is related with nature. The part where both overlap is the area of society and the area where the economic system is located. The intersection area is the area where information from both parts is exchanged. The cultural system created the rules for exchange of commodities, which stem from the environmental system. The rules or ideas on how this exchange works or should work are influenced by the conditions of the environmental system.

Classic economic theory differs from neoliberal theory as reaction to the limits set by the environmental system (land as limiting factor in classical economics, versus financial capital as limiting factor in neoliberal theory) (Gómez-Baggethun et al. 2010). The environmental problems people are facing in the last century are reflected in the development of new economic theories and methods like *Environmental* and *Ecological Economics*.

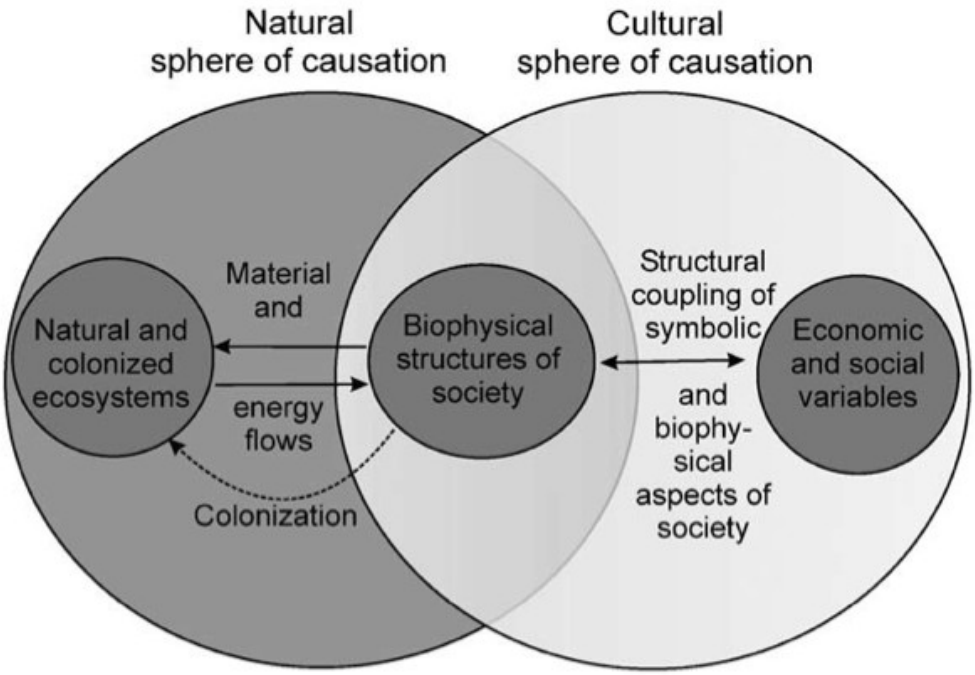


Figure 34: Socio-environmental system (Haberl et. al 2004:204)

However, getting back to the communication issue, I think that the price code is a very limited means of communication. This is the advantage of *Ecological Economics,* which uses different

kinds of codes. Looking at the development of *Environmental* and *Ecological Economics*, one can say that they evolved as reactions to the pressing environmental problems. The amendments of neoliberal economic theory that led to the development of *Environmental Economics* are, however, not as far-reaching as the amendments constituting *Ecological Economics*. While for *Environmental Economics* it was enough to simply expand their communication on so-far excluded environmental items, *Ecological Economics* also integrated other codes of communication. It is, however, hard to say whether *Ecological Economics* is a further development of *Environmental Economics*, or whether these two are really totally distinct systems.

Anyway, there is nothing wrong about using the price code for communication if there are individuals that do not understand other codes properly. Nevertheless, it remains questionable whether it is wise to focus on only one code, which is not able to capture the full meaning. The power of communication to transmit meaning can be seen when we think about different languages. People who live, for example, in cold, snowy areas have many different words to express certain qualities of snow. In other world regions the quality of snow generally does not matter, and therefore people have a much more limited vocabulary for snow. However, explaining to someone from a warmer climate the differences of snow can be challenging, since the matching words and thus meaning are simply missing. The same is true for the price code as means of communication. Prices can only communicate a single dimension of value, nothing more and nothing less. Another aspect of language important in this regard is plurality. Using different languages (codes) also allows us to think in different categories or cultural epistemologies. Reducing our communication to one single code means that we impoverish our cognition and means to reflect and communicate. Isn't the reason of learning other languages to build bridges to others? Accordingly, we should use different codes to bring the message across. And we should try employing those codes that fit best and not the ones that comfort the ones in power.

Taking a coevolutionary point of view, if there is no way to unite the two schools of thought, it is still possible that they develop further. I already indicated that comparing the different preanalytic visions from neoliberal to *Environmental* and finally to *Ecological Economics,* one can discover a development, while the *Ecological Economics* offers the most holistic and complete vision. As Daly (1996) pointed out, the vision of neoliberal economics is not completely wrong; it has its use. Analyzing only the flow of commodities and money between enterprises and households it can of course help (Müller 2001:420). Anyway, it is not very helpful if one tries to understand the bigger context. And as pointed out, it might not be the best idea to simply amend the small system in order to integrate the universe into it. Not the universe has to fit into the economic system; rather, the economic system has to fit into the broader context. Several times it is criticized that neoliberal

economics tries to adapt reality to their models, where it should be the other way round. Science tries to develop models to describe reality, to explain certain phenomena and to probably make predictions (Borgström-Hansson 2003:117). Hence if the economic system developed by neoliberal economic science does not fit with real conditions, it should be adapted. The model developed by *Ecological Economics* can be one option to work with.

I want to point out another issue regarding models. Müller (2001:420f.), for example, states that constructing models of reality only becomes a problem as soon as one does not realize the limitations of a model and believes that the model IS reality; hence when the model becomes normative. In doing so the model which was constructed to explain reality becomes itself a factor influencing reality, since it is the analytic framework through which we see reality. The same is true for indicators. I already discussed Daly's (1996:41) analogy with Heisenberg and the coughs as indicator for the state of health of tuberculosis patients. Daly pointed out that this is also true for economic indicators like GDP. Therefore economics, whatever school of thought originating from, has to reevaluate what already developed models really capture and what models need to be developed in order to capture particular aspects of reality, like problems related to human-nature interactions. So the way we think, we understand and see the environment influences our actions, which influence the environment in one way or another. The feedback we get from changes in the environment can change our understanding in reaction to the change. Again, this is a coevolutionary process. Humans do not necessarily react in the “right” way, as we see from the examples of collapsed societies. The messages of the environment are unambiguous. The question remains how we are going to react.

Part II

17. Introduction

So far I illustrated the differences of *Environmental* and *Ecological Economics*. I showed that particular preanalytic visions result in a certain theoretical underpinning of a respective scientific school of thought. Vision and theoretical underpinning again influence the methods which are developed and employed. How these fundaments affect practice was illustrated with the example of UNEP's GER. The development of UNEP's green economy concept runs through different stages, from a more *Ecological Economics* stage, where growth was not seen as the major goal and where growth was even contested, to the current stage, which is more in line with *Environmental Economics*, where growth is the facilitator of a transition to a green economy. Hence the preanalytic vision and the theoretical underpinning do affect policy.

Part II of this thesis is the empirical part, where I try to test my hypothesis. The analysis of part I showed that the two schools of thought do not have much in common, which should make cooperation difficult, if not impossible. The only commonality is the goal to protect the environment and using internalization in order to integrate the environment in humans' considerations. The question now is whether this commonality is enough to allow cooperation. On the first sight the ELD initiative seemed to be adequate to test my hypothesis, since representatives from both schools of thought contribute to it. This fact became clear investigating the background of the key contributors. Before conducting expert interviews I tried to analyze ELD's conceptual underpinning through literature and Internet research. I wanted to find out whether ELD exhibits a clear alignment with one of the two schools of thought, as was observable for UNEP's green economy concept.

However, to dig a little deeper I conducted expert interviews with nine key contributors to ELD. First, I did so because even if ELD has a clear position it does not necessarily mean that none of the contributors has another opinion. Second, if ELD does not have a clear position the interviews can help in finding out more about ELD's theoretical underpinning. Thus the interviews should reveal which school of thought the respondents follow. In the first place the interviews will test whether in reality the two concepts can be distinguished that clearly, or whether people take aspects of both schools. If both schools of thought are represented, the interviews will indicate on what base cooperation can take place. It has to be pointed out, that due to the sample size, the result of this research does not deliver a comprehensive picture of ELD's theoretical underpinning. Anyway it does allow an insight in ELD's processes, how much common ground and how many controversies there might be.

18. The Economics of Land Degradation Initiative

The ELD initiative is relatively new. Addressing the implementation of the *United Nations Convention to Combat Desertification* (UNCCD), it became of increasing importance only recently, compared to the efforts already undertaken to promote the other two Conventions that resulted from the *United Nations Conference on Environment and Development* (UNCED) in 1992. Contrary to the *Framework Convention on Climate Change* (UNFCCC) and the *Convention on Biological Diversity* (CBD), UNCCD was only established in 1994. All three conventions are intertwined, inextricably connected in the struggle on the way to a more sustainable acting humanity. The *Rio Declaration on Environment and Development* reaffirmed the *Declaration of the United Nations Conference on the Human Environment*, adopted in 1972. Already 40 years ago it was clear that humans massively influence the environment in a negative way, depriving themselves of the resources that allow their existence. It is sad and disgraceful to know that not much has happened since then. Humans are still on a track that might lead to their demise.

Anyway, the ELD initiative can be understood as a platform that tries to make our actions affecting the resource land in its broadest sense sustainable. This relates to actions of the public as well as to the private sector, to small-scale as well as to large-scale undertakings.

The history of the ELD initiative is outlined by Nater (2011), as well as on the ELD website (ELD[1]). According to Nater (2011:4) first steps that later resulted in the foundation of the ELD initiative were undertaken by the *Ministry for Economic Cooperation and Development of the Federal Republic of Germany*. Key for the formation of ELD was the cooperation of *International Food Policy Research Institute* (IFPRI) and the *Center for Development Research* (ZEF). These first steps date back to the year 2009 and in a meeting in Bonn in 2010 the foundation of ELD was agreed. ELD has its seat in Bonn, Germany, close to UNCCD's headquarter.

As just stated, ELD can be compared with preceding engagements like the *Kyoto Protocol* or the *Economics of Ecosystems and Biodiversity* (TEEB). Both initiatives try to internalize environmental externalities, may it be carbon sequestration or the preservation of biodiversity. ELD has the same goal, internalization of environmental externalities connected to land degradation, desertification and drought. It is argued that the economic aspects of land degradation became more pressing in the last years and thus the desire to illustrate the economic value of fertile land and to show the costs of degraded land was born. It is stated that UNCCD efforts to combat land degradation are weak due to the lack of economic valuation (Nater 2011:3f.). Also on the ELD website one can read that the main reason to start the initiative was to illustrate the economic value of fertile land. Although science already showed that land degradation has social and economic costs, this was

not recognized by policy makers (ELD[2] and ELD[3]).

ELD has five goals which are outlined on their website (ELD[2]):

- "We develop a holistic framework for the consideration of the economic values of land in political decision making processes;
- We compile and build a compelling economic case for benefits derived from sustainable management practices, the sustainable management of land and soil on a global and local scale;
- We estimate the economic costs resulting from the degradation of land and related ecosystem services and compare them to costs of protecting the land;
- We sharpen awareness of the value of land and related ecosystem services;
- We will propose effective solutions, policies and activities to reduce land degradation, mitigate climate change and deliver food, energy and water security worldwide."

Concluding from these goals it can be stated that the holistic picture that they want to draw is only expressed though monetary valuation. The word holistic can probably be understood as capturing the TEV (ELD 2013:11, 15f., 29ff.) of the resource land. Remembering what was stated in part I about the price code as communicator and concerning what is stated on the ELD website, one gets the impression that monetary valuation should serve as communicator. "The initiative seeks to draw attention of decision makers on all levels to the economic aspects of land degradation and ensure that this becomes a firm component of policy strategies and decision making processes" (ELD 2011:1) Moreover, ELD states that their vision is "[t]o transform global understanding of the value of land and to create awareness of the economic case for sustainable land management in preventing the loss of natural capital, preserving ecosystem services and addressing food, energy and water security" (ELD 2011:1f.). And ELD "[...] aims to make economics of land degradation an integral part of policy strategies and decision making by increasing the political and public awareness of the costs and benefits of land and land-based ecosystems" (ELD 2013[2]:10). These three quotes clearly indicate that economic valuation is used as tool for communication to transport meaning.

In economic terms the scarcity of land due to rising population and increasing demand is more and more recognized (see, e.g., ELD 2013:12). The utility of land, however, seems not to be acknowledged. If people were aware of the necessity to preserve fertile land, such a thing as economic valuation would not be needed. People seem to have forgotten that land is the basis to nourish human beings. Looking at the problem from this angle, it is reasonable to express the problem in a way that is understood by people: money. This notion is also expressed in ELD

interim report (ELD 2013:15) putting the paragraph heading *Speaking the language of public and private decision-makers* and explaining that decision makers are faced with decisions on how to allocate limited financial resources. Thus, without knowing whether investments in land preservation or regeneration pays off, they are reluctant to invest scarce financial resources.

The ELD interim report (2013:29ff.) provides a framework on how to implement economic valuation of land. First they suggest calculating the TEV of land, which calls for disaggregation of the different values (see Figure 3 in ELD 2013); afterwards it is explained which monetary valuation method[100] can be used to figure out the different values.

Although ELD calls for multidisciplinarity, hence the cooperation of different disciplines to capture the whole picture (Nater 2011:5, ELD 2013:11), ELD only uses monetary valuation. The aim of the initiative is to evaluate socio-economic costs and the benefits of better management. Moreover, policy strategies should be developed. Interdisciplinarity would be a feature of *Ecological Economics;* using only monetary valuation, in contrast, is one of *Environmental Economics*.

Also concerning methods, only CBA is employed (ELD 2013:21), which again rather fits *Environmental Economics*. It is stated that CBA allows comparison of all costs and benefits; thus the commensurability of values is believed in. ELD has the approach to compare costs of action with the benefits of action. They state that the costs are easy to calculate, while the benefits are not. Thus methods to detect the economic value need to be employed. Anyway, MCA is mentioned (ELD 2013:43f.) as an alternative approach. It is, however, argued that MCA has limits, which seems to be the reason why ELD rather wants to employ CBA. Moreover, they point to macroeconomic alternatives in contrast to CBA, which is a microeconomic method. Particularly the ELD (2013:44f.) report refers to SEEA and *Wealth Accounting and the Valuation of Ecosystem Services* (WAVES).

The role of education and information is also emphasized. They point to a six (plus 1) steps (see ELD 2013:42) approach to identify ecosystem services and undergo CBA. This framework can be applied as a participatory approach to decision making (ELD 2013:45f.). This idea is pretty similar to SMCE, but instead of a simple CBA, SMCE analyzes the options using other indicators. From the analysis in part I one can say that SMCE is promoted by ecological economists (e.g., by Giuseppe Munda). If a participatory approach to CBA is used, the only difference between CBA and SMCE is the reduction of monetary values in CBA. Since CBA is used rather than SMCE, this is another point indicating that ELD follows the *Environmental Economics* school of thought.

100See ELD (appendix I) for a list summarizing valuation methods.

ELD's business brief (ELD 2013[2]) also points to the importance of awareness raising. But this seems to be reduced to informing companies about potential risks of land degradation and the potential benefits that investment in land can generate.

As a precondition of environmental valuation to work it is stated that “[t]he appropriate technical, political, legal, cultural, social, and environmental conditions are needed to ensure the successful implementation of economic action and instruments for long-term sustainability” (ELD 2013:45). It has to be pointed out that exactly these issues might not be fulfilled in many countries. Moreover, if they are fulfilled it is likely that also other methods (decision making, which is not based on monetary valuation like SMCE) would work as well.

Apart from the interim report ELD also published a document (ELD 2013[2]) directed at the private sector. In contrast to the interim report the *ELD Business Brief* tries to illustrate why big private enterprises should care about the resource land. This is explained by outlining the risks to enterprises from land degradation and the opportunities that arise through appropriate land management. This *Business Brief* has a strong emphasis on reasoning why investment in land pays off. Ultimately this is done though the economic value argument. However, it is also pointed out that more or less all enterprises are connected to the resource land (ELD 2013[2]:11). Five points are stated why land degradation matters to companies. Three out of these five points argue that a relation can be found “[...] if you go deep enough” (ELD 2013[2]:11). These words show that ultimately human existence is based on the environment, but that this fact has been forgotten. ELD tries to re-awaken this knowledge.

It is interesting that initiatives like ELD try to press the money button in order to illustrate to the private sector that the degradation of the environment is harmful for their business. One might think that this is obvious. The fact that this is necessary also tells a lot about our current (economic) thinking. The difference between classic and neo-classical economy is that the former identified natural resources and the latter financial capital as limiting factors. It was explained in part I that the Industrial as well as the Green Revolution resulted in humans believing in being victorious over the constraining forces of nature. This idea infiltrated our thinking, our perceptions and now that it becomes more and more obvious that humans are still dependent on nature, it is necessary to revise the neo-liberal thinking. Interestingly, this is done without challenging the neo-liberal theory *per se*. *ELD´s Business Brief* gives the impression that monetary valuation exactly tries to explain to the private sector that the environment (its quality and quantity) is a limiting factor.

Also for the private sector ELD only uses monetary valuation as a method. Enterprises have to include the resource land in their standard protocols, which are based on simple cost-benefit considerations. Indeed, this is the base for enterprises' decision making and it would probably not be a fruitful idea introducing a method which is not adapted to conventional methods. Again one can argue that ELD simply employs a method which is widely accepted in order to find open ears. The *Business Brief* not only illustrates theoretically why investment in the resource land pays off, it also brings some case studies, which support ELD's arguments.

However, it has to be pointed out that an approach which is merely based on monetary valuation might be faced with the problem that CBA can unravel, that investment in land does not pay off. On the one hand it seems to be reasonable to use a monetary based method (CBA) which is used in business to support the decision making process. On the other hand this makes it the only moral authority. Even Corporate Social Responsibility (CSR) is ultimately based on considerations concerning the maximization of profits.

The *Business Report* (ELD 2013[2]:23) states three options for how land degradation can be included in companies' decision making. The first option is governmental regulation, which might affect a lot, since it is obligatory. The reverse side of it is that enterprises are forced to comply and do not necessarily adapt more environmentally friendly thinking. The other two possibilities are company driven. Anyway, it can be stated that hardly any company will adapt environmentally friendly operations if they do not expect some kind of financial return (direct or indirect). “Land degradation is in need of a (best-selling) business concept” (ELD 2013[2]:24). This statement illustrates the perversion that is inherent to monetary valuation and to the basic concepts monetary valuation is built on, scarcity and utility. First, it seems to be necessary to draw down natural stocks in order to make them precious, which second, generates the increasing utility one gains through preservation. So if the business concept of land degradation does not bear fruit economically, the environment simply loses out. But can we really afford this?

In contrast to UNEP's GER, analyzing the publications of ELD one does not get a clear picture whether they are following *Environmental* or *Ecological Economics*. Indeed, apart from monetary valuation no other method is used, which would be an indication that ELD follows the *Environmental Economics* concept. However, the statement that monetary valuation is used as means of communication and the willingness to cooperate with other disciplines are characteristics of *Ecological Economics*. Also, looking at the scientific contributors to ELD one does not get a clear picture. Very prominent representatives of both schools of thought are contributing to ELD (similarly to UNEP's green economy concept). Both Edward Barbier – environmental economist –

and Robert Costanza – ecological economist -- contribute to the initiative. However, Robert Costanza is not reluctant to use monetary valuation as a means of communication (Costanza et al. 1997).

Borgström-Hansson (2003:121) points out something similar concerning the use of methods which do not fit a school of thought's attitude, but are from the *Environmental Economics* point of view. She argues that although environmental economists do not believe in complete or nearly complete substitution, since they also know that humans need certain environmental commodities to survive, they still use *Environmental Economics'* methods. Therefore they still follow the weak sustainability concept, adhering to the belief in substitution. A similar observation can be recorded for my interview results. The statements of my interviewees sometimes do not really match with the methods they use. One explanation can be that they indeed do not believe in substitution, but that they use internalization and monetary valuation methods as means of communication.

Therefore the interviews were conducted in order to get a clearer picture concerning ELD's theoretical underpinning.

19. The Interviews

The interviews were conducted via *Skype* ©; the conversations were recorded and transcribed for analysis. The interview has a semi-structured design, employing open-ended as well as concrete questions. The questionnaire was comprised of ten main questions and several sub-questions, which were only asked if the interviewee's response was not sufficient. Two of the ten main questions required the interviewees to rank some options. According to their ranking, afterwards a corresponding score was attached to every option. The questions were based on the differences that I could investigate through my literature research revealed in part I of this thesis. The questionnaire can be found in Appendix I. No names of interviewees are revealed; interviewees are represented by numbers from 1 to 9. Anonymizing the interviews was a deliberate decision, in order to allow interviewees to speak frankly. I interviewed nine contributors, bit but I tried to get a bigger sample, which was not possible due to time constraints. The interview partners were chosen by their engagement in the initiative concerning their participation in two ELD and / or the second scientific UNCCD meeting as well as according to their internal ELD engagement (e.g., working group leader)

19.1. Analysis of the Interviews

In a first step of analysis I simply tried to find similarities and differences of the statements made by the respondents. The answers are scanned focusing on key words and disaggregated in sense

units that transport the meaning of these key words. This is to show where respondents share common ground and where major disparities can be found. Only in a second step (see discussion) I tried to find out whether a differentiation in *Environmental* and *Ecological Economics* is possible.

Question 1: What is sustainability for you?

Question number 1 served as opener for the interview and dealt with the interviewee's understanding of sustainability. Quite different components were mentioned, which will be outlined in the following.

Six interviewees mentioned a time component, while two referred to longevity and four to intergenerational distribution. Another category is compensation, which again can be divided into an understanding of making trade-offs or to keep things balanced.

Interviewee number 7 stated that the understanding of sustainability depends on the discipline one belongs to. The interviewee distinguished between the natural scientists, following a strong sustainability concept, thus making no or very limited trade-offs; on the other side is the economists' point of view, following the weak sustainability concept which entails making trade-offs. This respondent was quite happy to navigate between the two. Therefore one can say that sustainability has a “context dependency” component.

Other definitions follow the categories of normative or positive sustainability understanding. The former was used by interviewee number 4, stating, “So what do we really mean by it, what do we really want to sustain is the question. Just having something being sustainable does not mean that we want to sustain all the bad things that we have now. We want to improve the world, we want it both sustainable and desirable” (4). A similar approach was stated by interviewee number 3, who puts people at the center of the sustainability concept. This could also be categorized as an anthropocentric perception of sustainability. In contrast, respondent number 9 stated that looking at nature or the universe, we see that this is a quite sustainable system. This positivistic observation could also be classified as an eco-centric perspective of sustainability.

Respondent number 8 had a rather negative approach to sustainability, understanding it as means to prevent environmental collapse. Another feature of sustainability mentioned by interviewees numbers 5 and 1 was that it entails quality and quantity. Moreover, sustainability can include different dimensions, from economic to social to cultural to environmental. Finally, two respondents referred to official definitions, the Brundtland report and the Rio Declaration.

After this opening question the first sub-question inquired whether different kinds of capital are rather substitutes or complements from the respondents' sustainability perception.

None of the nine interviewees contested that manmade and natural capital are complements. Some argued that all kinds of capital (however one may categorize them) are necessary and that a kind of balance is needed. Five out of the nine emphasized the complementary feature of natural capital stocks, since they are the base for human survival. Three stated that natural capital has to be drawn down to a certain extent in order to build up the other capital types. Two indicated that the important point of sacrificing natural capital is the question in what kind of other capital it is reinvested and what it is consequently used for. “Personally, I'd rather have the money invested in developing or improving current renewable energy supply and technologies, rather than have the money invested into tar sand exploitation, because it is easy, because we do not need to readapt our cars” (7). “Manmade capital can sometimes be quite effective at using up, exhausting natural capital. Human-capital does not necessarily lead to more sustainability at all. And in fact in history there are many examples of humans destroying their environment although they have human capital” (9).

The role of technology as a substitute for natural capital was mentioned by four respondents. Two out of these four pointed out the limits and negative side effects of substitution. “To some extent, if you come back to ELD, some farmers try to substitute lost soil fertility through adding more fertilizer, but to some extent they can manage. But this also involves additional costs, and they could have it also cheaper to get the same output... They add more and more fertilizer, but also have undesirable side effects, like ground water pollution” (3). The other two rather emphasize the possibilities provided by technology in terms of increasing nature’s efficiency. “One can intensify crop production in one hectare and get 10 tons, but they have put in some human capital and fertilizers and so on to get that 10 tons. If they don't do that they would need 5 hectares to get the same amount. So there we see the substitution of natural capital by human capital, which is the land area” (2). “There are a lot of services that ecosystems can provide, e.g., wetland; water filtration – that service would replace waste water treatment plants, then there are complements; a dam provided by humans which can also contribute to the natural capital. So it can go both ways” (8).

Basically it turns out that the major difference is to what extent different types of capital are complements or substitutes. As interviewees numbers 4 and 7 point out, this can be distinguished in the strong and weak sustainability concept. This is also related to the assumption to what extent,

for example, technology – as a result of increasing human capital – can increase efficiency and thus the output from the natural resource stock.

Question 2: Would you please rank the following concepts in descending order from the most important term to the least important term regarding sustainability (sustainable development)

a) investment in technology in order to promote sustainability
b) controlling the population number in order to allow sustainability
c) changed production and consumption patterns in order to permit sustainability
d) fostering economic growth in order to facilitate sustainability

The task for the second question was to rank four options in descending order starting from the most important to the least important regarding sustainability. Figure 35 shows which option gained the highest score. In order to illustrate this ranking one, two, three and four were attached the values 4, 3, 2, 1, respectively. The more often an option was ranked in a higher place, the higher the overall score. It can be seen that option b) controlling population number got the lowest and option c) changed production and consumption patterns the highest score. Interestingly, economic growth is only in third position and option a) investment in technology is second.

Figure 35: Ranking question No.: 2

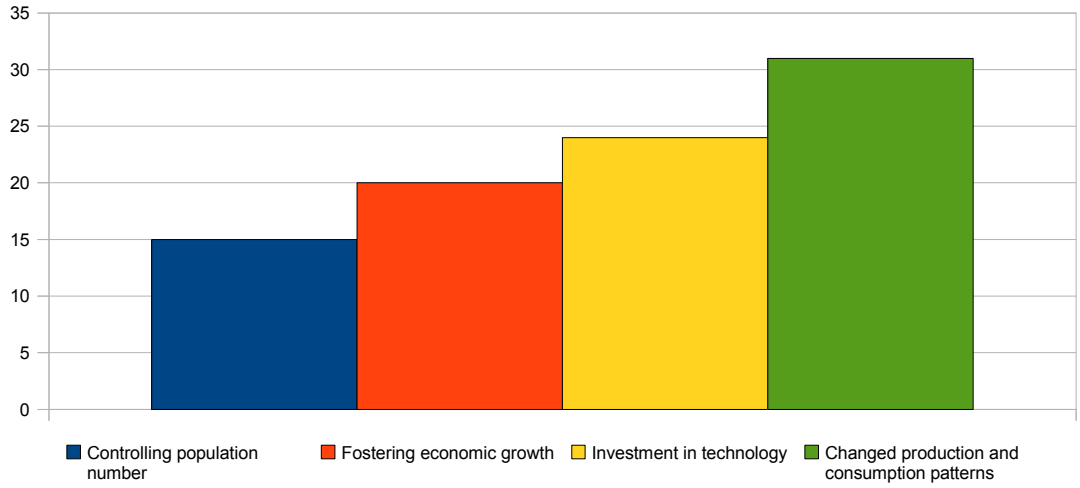
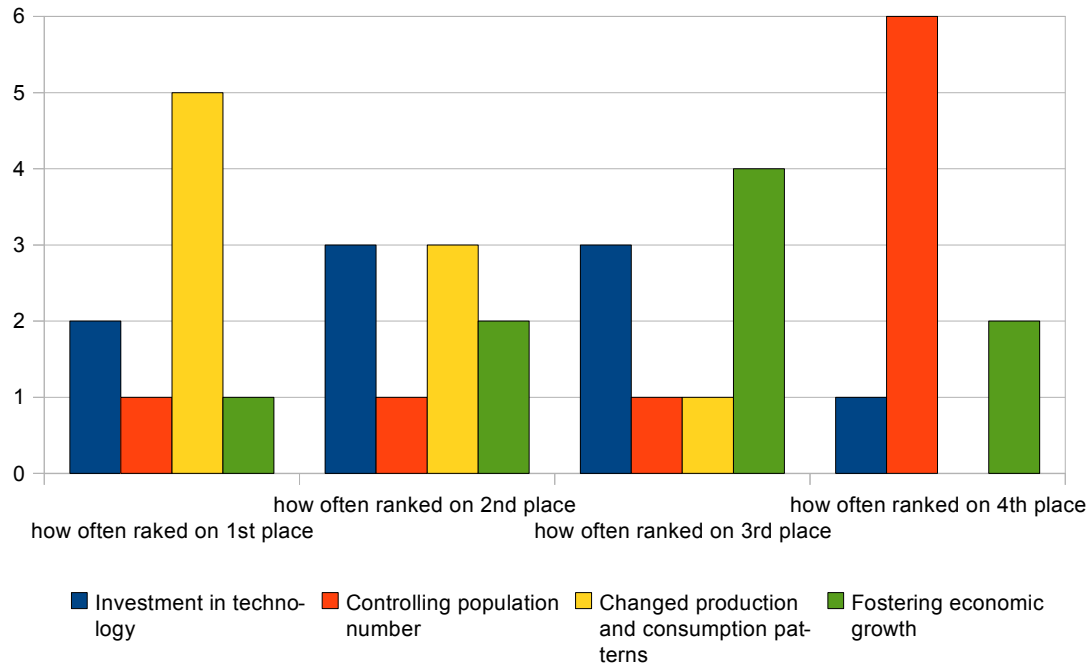


Figure 36 depicts how often the single options were ranked in places one, two, three and four. Most respondents placed option c) in place one, followed by three people who still placed it in second position. Only one placed it third and none in last place. This shows that eight interviewees perceive it as the most important or very important component of sustainability.

Figure 36: Distribution of rankings question No.:2



Investment in technology is placed in the middle. Three respondents placed it in second and third place each, two in first and one in last place. Option d) economic growth exhibits an unexpected pattern. Interestingly, it is not the most important one and only one placed it first. Two placed it second and another two even placed it last. Most interviewees placed it third. It is thus not negligible, but also not of top priority for sustainability according to the respondents. And finally, option b) controlling population number shows a very clear picture. Most respondents put it in last place. The other votes are equally distributed over places one to three, with one vote each.

As a sub-question I asked why the interviewees chose this order. Now I want to go a step further and try to discuss this ranking.

Let us start with option a) investment in technology. The two respondents that placed it in first rank reasoned its importance for sustainability with its potential to increase efficiency. “Technology is a predominant and key contributor to productivity growth” (3). It has to be noted that one respondent who ranked option c) changed production and consumption patterns in first position emphasized the huge role of technology in facilitating this change. Anyway, this person ranked technology second. The same argument was made by respondent number 5, also ranking technology second. Increasing efficiency was also one argument putting technology in second place. The three

interviewees ranking technology third argued this in stating that technology is not necessarily leading to sustainability. “The problem is, it is a good servant but a poor master” (4). “I don't believe in technology providing the miracle solution and we can just keep on going” (7). “We tend to use technology for things like the atomic bomb and flying to the moon” (9). There was only one vote putting technology in last rank. This was reasoned by pointing out that there is already enough technology invented and that we should rather invest in its implementation. The same argument was also stated by respondent number 1, who in contrast ranked it second.

From this it can be concluded that the role of technology to promote sustainability is perceived very differently. Respondents 1 and 6 had the same argument but chose a completely different ranking. For number one the fact that there is already a lot of technology out there which just has to be implemented contains a bigger chance in promoting sustainability than it has for number 6. This argument thus does not provide us with a perception that lets us clearly reason a particular rank, although it is interesting how the same argument can be interpreted. A distinction can be found in the statements concerning increasing efficiency and facilitating changed consumption and production patterns, resulting in a rather high rank versus statements expressing diluted trust in technology leading to the opposite.

Controlling population number seems to be the most controversial option. Six respondents ranked it last and only one on the first place. From these six two argued that population number does not necessarily have a negative effect on sustainability. “From Ester Boserup's ideas you can clearly see that population growth has led to intensification and better outcomes. But this does not mean that I am advocating for more and more people. It is not priority for me” (3). This opinion was shared by respondent number 2, who also pointed out that official projections concerning the development of population number show that they will stabilize. I would categorize this opinion as “optimistic”, which was shared by respondent number 1, who believes in a natural self regulation. The remaining three interviewees who ranked it in fourth place stated that it is an important issue but politically and from a human rights perspective difficult to implement. The same argument was used by interviewee number 6, who still placed it in third place. Interestingly, respondent number 9 also pointed out that the population issue is a political taboo. “Since the 60s the population issue became more and more unpopular” (9). However, this interviewee emphasized that more people result in more resource throughput, from which it is followed that population number has to decrease. Therefore interviewee number 9 ranked it in place one. The argument of increasing throughput was also stated by respondent number 4, who placed it in second place. This respondent also indicated another issue related to population: equal distribution among the population. Hence this argument already hints in the direction of changed production and

consumption patterns, which will be analyzed next.

Anyway, to conclude it can be said that reasons not to focus on the population issue are optimism concerning self regulation, the missing evidence that high population number has generally negative effects on the environment and the difficulty of implementing policies reducing population number. On the other hand, one can find the biophysical argument concerning the positive correlation between population number and resource use.

Changed production and consumption patterns exhibit a strong support and are five times in rank one and three times in rank two. Only one ranked it third and no one ranked it last. Interviewee number 3, who ranked it in third place, argued that chaining patterns may be a long term undertaking and is not so easy to implement. The three respondents who ranked it second most important stated that waste reduction is a big issue that has to be tackled. Interviewee number 7 has the opposite opinion to number 3, putting option c) first. This interviewee stated that changed patterns are a relatively easy means to promote sustainability. “Changing the patterns feels like something we can do within the next years” (7). Interviewee number 7 also came up with other reasons for the importance of changed consumption and production patterns. One is the waste reduction argument; another was increasing efficiency. “It is not necessarily producing less as such, as producing better” (7). A similar notion was mentioned by respondent number 8, who emphasized the importance of technology in order to achieve changed production and consumption patterns. “Technology shifts the curve and for me the pattern is the technology shift” (8). An additional statement regarded what I would categorize under the “sufficiency debate”. Interviewee number 9 pointed out that it is impossible to keep within sustainable limits if everyone has the typical Western life style. Interviewee number 1 also used the sufficiency argument, stating, “We are consuming, especially in the developed world, too much, beyond our needs; we are producing in order to satisfy this consumption a lot of unnecessary extra things, again just for the sake of keeping up the GDP and other growth indicators” (1). This fixation on the current economic paradigm was also stated by respondent number 5, who understood changing patterns as a means to transform the paradigm. A similar argument was used by respondent number 4: “Things that are currently out of the market. So we have to move away from market commodities and to non-marketed commodities. Because that will reduce the impact on the environment and at the same time improve quality of life” (4).

To sum up it can be stated that out of these nine interviewed only one had a rather negative attitude toward option c). The reasons for giving option c) a high rank range from considerations concerning efficiency to ones that embodied the notion of a changed idea of consumption. This can

also be understood as the distinction between shifting production and consumption to greener sectors and making the production and consumption process greener and the behavioral part which aims at reducing consumption (of market goods). Corresponding interviewees according to their answers to one of the two parts, the ratio is 4 to 3, 4 rather on the shift and 3 on the reduction side, while one respondent cannot be categorized at all. One argued in both ways and one would accept reduction but only under the precondition that quantity is paid off by quality. It can be stated that although option c) seems to be of high importance for the majority of the respondents, the reasoning differs fundamentally.

The last option was fostering economic growth. On the first glance one can see that the majority does not perceive it as being highly important. Only one ranked it first and only two ranked it second. On the other hand four ranked it only in third and two in last place. Respondent number 6 had a rather “down-to-earth” point of view, putting it in first place and stating that it is the accepted world view. “It is inevitable the way world works; it’s based on money. We cannot ignore that, even though we have the obvious limits to economic growth” (6). Hence for this person, the reason for putting it first seems to be based on pragmatic considerations. Interviewee number 3 reasoned the importance of economic growth for sustainability with the EKC, putting it in second place. “Once you are rich you have more options to behave sustainability, you have more capacity, you have the means to behave, and poor may simply have no option” (3). This argument was also used by another respondent, who only ranked it third. Interviewee number 2 indicated that economic growth is not a precondition for sustainability and is rather needed for poverty reduction. Interviewee number 1 expressed a general antipathy against the term economic growth and emphasized that we need a shift from economic growth to economic development. The two who ranked it last argued that it does not necessarily lead to sustainability and that economic growth does not agree with sustainability.

The importance of economic growth regarding the promotion of sustainability seems, according to the respondents, generally not to be too high. The other factors are perceived as being more important, and investment in technology and changed production and consumption patterns are understood as means that promote economic growth. Apart from the two (or three if we include respondent number 1) who ranked it last, economic growth is generally not neglected, but its role is still not of top priority. Reasons for giving it a higher rank are pragmatism and the belief in a EKC pattern; giving a lower rank is simply reasoned by the little and limited importance of growth for sustainability.

It has to be added that two of my respondents stated that they would have other priorities not

offered in the questionnaire. Interviewee number 2, for example, emphasized the role of institutions and good governance; interviewee number 4 instead indicated the importance of a general shift in human understanding of wellbeing and its measurement, a point which was also mentioned by respondent number 1.

Question 3: Do you think GDP (Gross Domestic Product) is an adequate indicator for economic progress?

My third question dealt with indicators and whether they are adequate. First I wanted to know if the interviewees think that GDP is an adequate indicator to measure economic progress. All nine stated that it is not adequate and added that it should be complemented with other indicators that measure happiness, natural stocks or distribution of wealth. Next I wanted to know whether they think that economic growth is more important for developing countries than for developed ones. Four respondents did not expand on that question since they find that GDP is generally inadequate. One stated that it is equally important but this would entail the revision of the accepted indicator for wealth. Respondent number 1 stated in the similar direction, pointing out that economic growth is needed since it creates jobs and thus wealth. However, it was also emphasized that growth can also follow a green growth pattern, which would also help generate jobs. Respondent number 3 stated that it is more important for developing countries due to decreasing marginal benefits. Interviewee number 8 did not respond to the question and stated that concerning natural capital, it would be more important for developing countries since they are more dependent on them. Finally, respondent number 7 pointed out that this should be decided by the respective countries. Moreover, this respondent indicated that GDP could be abused in order to get more development aid.

So one can say that the common denominator is that the GDP indicator is perceived as being too narrow and that it gives a flawed picture.

Then I wanted to know whether it could be an option to restrict economic growth to developing countries in order to stay within sustainable limits. Two interviewees stated that this is not a good idea. Growth should not be restricted, but rather nations have to find a common path to sustainability. A similar vein followed the answer of respondent number 9. This respondent stated that economic growth, if it follows the path of Western nations, would still cause environmental problems in developing countries. Moreover, the respondent pointed out that GDP is flawed and if such an approach was adopted it would simply validate the GDP concept, which this respondent is against. Again a similar answer came from respondent number 4, who stated that developing

countries also need to increase some of their conventional production and consumption, but that they should use environmental friendly means. This respondent, however, also stated that (green) economic growth would be more important for developing countries since they have a right to catch up. Developing countries, according to respondent number 4, are allowed to have a stronger green economic growth, while developed countries should cut down their consumption. In contrast, respondent number 5 is against such an idea, since it would harm global trade and developing countries. Thus this respondent also promotes green growth. Interviewee number 3 generally does not see a reason for restricting growth since growth already automatically slows down at a certain point. Finally, interviewees numbers 7 and 8 are against such an imposed limit, because it would be a heavy interference in a nation's rights.

Summarizing, it can be stated that economic growth is more or less promoted by all respondents but that they all want to follow a different pattern of economic growth, green growth, a concept that is explored in question 6. If we assume an environmentally friendlier way of achieving economic growth, only one clearly indicated that this is more important for developing countries due to their right to close the gap.

Question 4: In contrast to GDP, there are also indices that measure not only economic growth but also include social factors. One is for example the HDI. Do you think that Human Development Index, an indicator measuring literacy, life expectancy, as well as economic growth, is an adequate indicator for human's quality of life and human development?

Question number 4 examined whether indicators or indices which do not only focus on GDP but include also other factors like literacy or life expectancy are adequate to measure human quality of life. All nine respondents agreed that such indicators do a much better job than GDP does. Some respondents still pointed out that such more complex indicators are not perfect and can also be abused. Again I asked whether getting a better position according to such indices is more important for developing than for developed countries. Respondent number 7 indicated that indicators can be abused politically and hence indicator results and reality might be a different kettle of fish. Two stated that it is important for both. Another two indicated that it is more important for developing countries, while respondent number 3 pointed out that it is cheaper to bring a country with a low level on a higher one than to improve the status of an already high ranked country. In contrast respondent number 8 stated that it is more important because developing countries have to catch up. Respondent number 6 said that it depends on a nation's preference what indicator or index to use and hence what priority of improvement they have. One interesting result is that respondent number 1 stated that comparing a certain indicator globally can lead to a

positive competition, awakening people's desire to improve their position. On the other hand, respondent number 7 indicated that some nations may want to keep at a low level in order to get more financial benefits.

Concluding, it can be stated that more comprehensive indicators are preferred because they better reflect wellbeing, which is the aim of economic growth in the end. GDP indicator is perceived as too limited and thus its usefulness to measure wellbeing is contested. The topic of equity that I wanted to analyze with the sub-questions delivered a biased picture. Some stated that the notion of catching up would give developing countries priority, while most seem to have the opinion that (green) economic growth as well as progress in human wellbeing is equally important for both. The major issue seems to be how to define wellbeing, how to measure it and how to deal with shortcomings that any indicator inevitably brings along.

Question 5: Are development and growth are interconnected?

Question 5 examined whether the interviewees think that economic growth and human development are interconnected. All nine respondents stated that they are connected. Then the first sub-question tried to analyze whether the interviewees think that they promote each other or if one facilitates the other. And again all stated that it does, can or should work in both ways. Respondent number 1, for example, stated that economic growth needs human development in order to replicate and improve the system. However, this respondent stated that nowadays there is a fixation on economic growth alone as the provider of wellbeing. Respondent 2 pointed out that human development always leads to economic growth but that economic growth does not necessarily lead to human development. A similar answer came from respondent number 3, who stated, "Doesn't development already include growth?" Two respondents related their answer to what is called the "threshold hypothesis". Interviewee number 7 stated that at a certain point economic growth does not necessarily increase human development anymore. Interviewee number 4 argued in a little different manner, stating that both are necessary and that at a certain point one has to switch from growth to development.

A second sub-question investigated whether the interviewees think that for sustainability economic growth and human development are equally important. Four out of the nine respondents stated that they are equally important. Two of these added that this is only the case if we rethink our understanding of economic growth, pointing to the concept of green economy. Respondent number 5 did not give a statement on whether one is more important than the other and emphasized that economic growth has to be redefined in order to be sustainable. From the four people who stated

that they are equally important, one added that there are phases of growth and phases of development. Three stated that human development is more important. Interviewee number 7, for example, stated that human development and sustainability are the end and economic growth is the means. Interviewee number 9 stated that economic growth builds on human development. Respondent number 1 has a completely contrary point of view, stating that from a strong sustainability perspective both can have pretty unsustainable results.

From question number 5 and its sub-questions it can be summarized that economic growth and human development are perceived as being connected. However, the way they are connected is understood pretty differently. The answers partly hint to the problem of GDP fixation and that for reaching human wellbeing much more than simply GDP growth is needed. Moreover, human development seems to be understood as the better warrantor to reach economic growth. The critique on the classic concept of economic growth is again supported through the answers to the second sub-question, where the typical concept of economic growth is rejected and one that relates to the green economy concept is promoted.

Question 6: How would you define green economy? What is your understanding of this concept? And how is it related to sustainability? Are they related; in which way? If not, why not?

The next question deals with the concept of green economy, how the respondents define it and if according to their opinion it is related to sustainability and if so, how. All respondents somehow related it to the idea of sustainability; however, two had a rather negative attitude toward the green economy concept. Interviewee number 9 stated that it is often abused in terms of green washing. Respondent number 4 does not support the notion of growth that it still entails. It is a step in the right direction but not far enough. This growth notion was also indirectly touched on by interviewee number 1 in using the term economic development rather than economic growth. For this interviewee green economy is defined as economic development plus social equity and environmental sustainability. The notion of not drawing down natural stocks was mentioned pretty often, but again the term growth was not used throughout. The statements of interviewees numbers 2, 6 and 8 differed mainly in that number 8 did not use the word growth. Respondent number 2 stated that sustainable management of resources promotes economic growth. Others related it with terms like “less intensive carbon economy” (5), or “bio-economy”, which relates to the increasing importance of natural resources and the increased use of renewable energy (3). Two respondents mentioned the feature of intergenerational equity by stating that natural resources are not exploited at the expense of future generations. The relation of sustainability and green economy exhibits two sides, one that promotes that green economy facilitates sustainability

and the other stating that sustainability is a means of green economy. Respondent number 7 consolidates these two approaches, pointing out that it is a loop system.

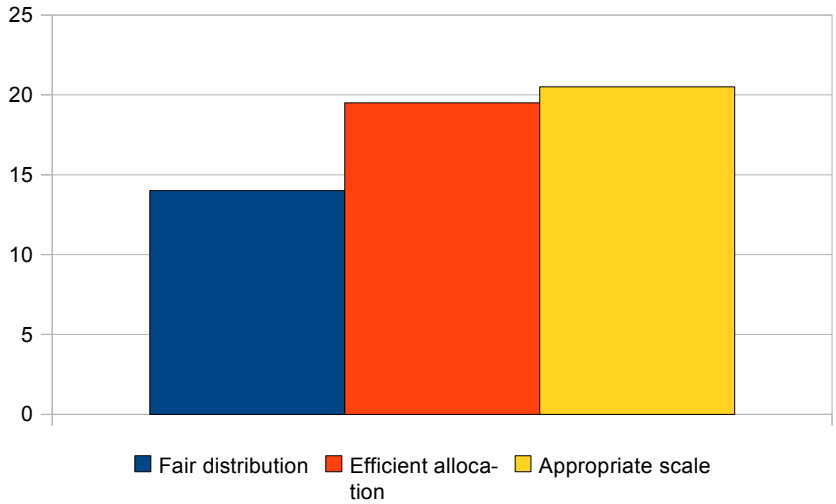
In a nutshell apart, from the different features of green economy except for two interviewees, the attitude toward green economy were rather positive. Economic growth seems not to be at the center, which corresponds with the results of question number 2.

Question 7: Would you rank the following concepts descending from the most important term to the least important term regarding sustainability?

a) *Appropriate Scale: the aggregate size of the economy in relation to the size of the ecosystem or in relation to the natural resources available.*
b) *Fair distribution: the fair distribution of goods and services throughout the global population.*
c) *Efficient Allocation: the efficient allocation of production factors and commodities between the global population.*

Question number 7 is based on Herman E. Daly's distinction of scale, distribution and allocation. Through asking the respondents to rank these options I again hoped to find out whether they follow the *Environmental* or *Ecological Economics* approach. The interviewees had to rank the three options according to their importance for sustainability. It has to be stated that two people had problems with giving a ranking and placed two items at rank one. As with question number 2, I assigned a value to every option according to their rank. In case two options shared a rank I attached both the value 2.5 and the third one got the value 1.

Figure 37: Ranking question No.:7



From Figure 37 it can be seen that the outcome is a very close result. Option a) appropriate scale is only one point ahead. It has to be pointed out that option a) was the one which I had to explain most, while the others were clear to the interviewees. Option b) fair distribution has the least points and also turned out to be a tricky option for the respondents due to the word “fair” and the question of what fair is.

Figure 38: Distribution of rankings question No.:7

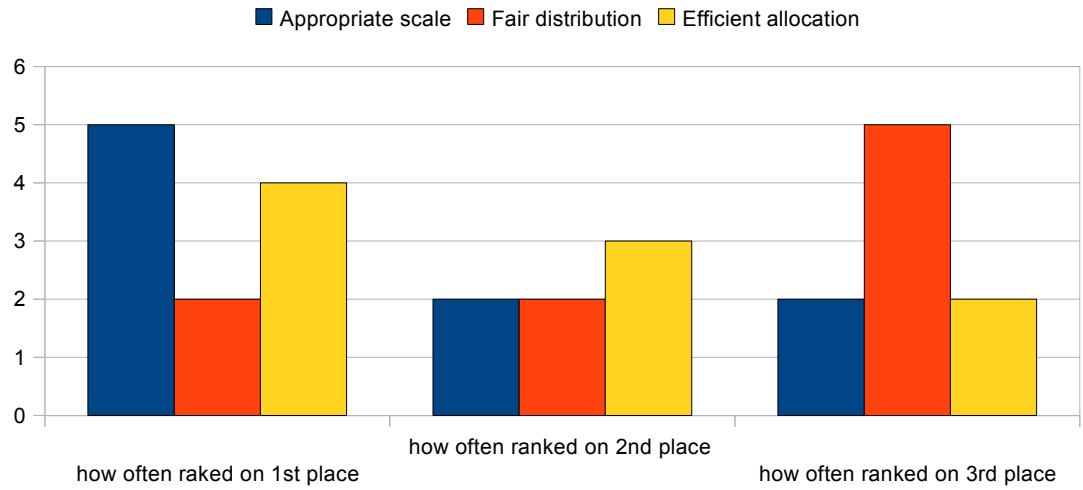


Figure 38 shows how often each option was put on first, second and third rank. As can be seen option a) and c) are nearly of equal importance and distribution is perceived as not being that important for sustainability.

In a next step I further asked why they chose this particular ranking. The interesting question is the reasoning of respondents who gave a) or c) a high rank and those who gave it a low rank.

Concerning scale, 5 ranked it in first place. Interviewee number 7 stated that the ranking would depend very much on the context and that option a), in contrast to the other two options, which are economic concepts, fits more into natural scientists sphere. It was emphasized that they are closely related, that one cannot pursue one while neglecting the other two. A similar statement was made by interviewee number 4. Interviewee number 9 stated that scale is the concept most closely related to sustainability and that markets should not be the only institution that tackles environmental issues; governmental regulation is needed as well. Two respondents stated that scale is the concept taking into account that we should not exceed the planet's carrying capacity. The same statement was made by interviewee number 8, who, however, put scale in second place. In contrast to those who put it first are those who put it last. The arguments for doing so range from pure optimism, that there is still room for action hence restrictions are not needed. Interviewee number 3 also stated that it is impossible to make such restrictions.

Regarding distribution, the major reason this was not put first was that fair distribution can lead to inefficiencies and that it is not necessarily related to sustainability. “Fair is not necessarily an efficient economic principle” (8).

Finally the efficient allocation option has to be discussed. Only two put it in last place while interviewee number 4 did not really explain this ranking. Interviewee number 5, in contrast, stated that efficient allocation can have pretty unsustainable results. On the other side of the ranking, people had different reasons for their choice. Interviewee number 1 pointed out that allocation should avoid imbalances and that this also has a welfare implication, since things are allocated where they are needed most. A similar argument was stated by interviewee number 3 who referred to the concept of Pareto efficiency, which means to maximize everyone’s welfare. Two respondents also indicated that allocation can avoid inefficiencies and thus reduce waste. And finally two stated that they rank it first, because they are economists. Only respondent number 2 could afterwards reason why economists put it first.

Confronting the arguments for putting allocation or scale first shows that there is a group of respondents who have a preference for efficiency and one for keeping an eye on not overshooting biophysical limits as the most appropriate means to promote sustainability.

Question 8: Some economists say that environmental problems occur due to market failure / missing markets. Therefore their approach is to integrate the external environmental goods and services into the market system in order to get the problem solved. What do you think about this approach? Can environmental problems be solved through this method? Yes / No … Why? (Examples are carbon trading, environmental damage due to production)

The eighth question investigated whether respondents think that internalization can solve the problem on its own. None stated that internalization is THE solution. Four interviewees first emphasized the role and necessity of internalization and only the sub-question asking for market limitations revealed that they think that governmental intervention is needed. Similarly, interviewee number 9 stated that governmental regulation is needed but added this right away. In contrast, interviewees numbers 5 and 6 indicated that monetary valuation is too narrow, since it excludes other kinds of values on which humans base their decisions. Similarly, interviewee number 4 stated that it is a useful tool which works only on the allocation level and neglects the other two afore-examined levels, distribution and scale. Finally, interviewee number 7 stated that internalization is a tool but ultimately education is what will be the solution to environmental problems.

Hence, although they all contribute to an initiative that predominantly deals with internalization, no one thinks that this is the only solution. Other factors are important as well, or even more important. Indeed, four respondents state that internalization is the first step and only in the case that markets fail do governments have to step in. However, this is confronted by five people thinking that internalization is only a very limited tool. Indeed, not all contributors to ELD were interviewed, but this is still a very surprising result.

Question 9: Cost-Benefit Analysis is a commonly used method to compare investments. To include natural resources or generally the environment into these calculations, a monetary value needs to be attached to them. Some say that it is not possible to put a monetary value on the environment. What do you think about this?

Question number 9 examined whether the respondents think that CBA is problematic since one has to attach a monetary value on nature, where some people state that this is impossible or ethically questionable. From the answers I got, it can be stated that the commonality is that it seems to be better than doing nothing. Interviewee number 1 stated that it is not so much about putting a price tag on something but rather to get a common understanding of the value of something. Thus value can also be expressed in qualitative terms. Respondent number 2 states that due to the shortcomings the valuation process should follow a participatory approach, including the opinion of all involved stakeholders. In contrast respondents numbers 3 and 8 refer to techniques which can overcome the limitations. Respondent number 4 stated that it is better than not doing it “because there is a time we make a decision about that; we implicitly value them. It is a choice we have. Should we value nature or should we not value nature? We do value nature, and then in monetary terms we do it all the time everyday. The problem is we don't recognize it. To claim that we don't or that we shouldn't is just denying that fact, makes it worse.” And respondent number 7 states that it is a kind of final attempt to get people’s attention: “Well, I see it as a means to an end. If there is complete overexploitation of the resource and the ethic message doesn't come across to policy makers and the private sector, we probably have to press the money button, so that they probably finally pay attention.”

A sub-question was whether they know of and / or would support other tools than CBA, which include other qualitative and quantitative values. Four could state other methods or initiatives which use other values and four would generally support using methods that not only focus on monetary values. One respondent stated that the method used depends on the target group and the method they are used to. Two stated no, arguing that ultimately it boils down to a cost benefit decision

based on money.

Concluding, it can be said that monetary valuation, although it has its limitations, is a uniting factor. However, there is not such a high agreement on the exclusive use of monetary valuation or CBA. The support for other methods was, according to the answers, quite high.

Question 10: For environmental commodities to be included in economic considerations two factors need to be fulfilled: Utility to humans and perceived relative scarcity are preconditions for environmental goods to be included in economic analysis. These two conditions are based on subjectivity, hence the perception of utility; as long as something is not perceived to be useful it is excluded. Another condition is knowledge; as long as humans don't have knowledge about relative scarcity, they are also excluded (e.g., ozone layer). What do you think about the problem that this inclusion is dependent on human's knowledge and attitude (needs)?

The last question tried to challenge basic assumptions of neoliberal economic thinking, which is that in order to get a market price a commodity has to be useful to humans and needs to be perceived as relatively scarce. The question wanted to analyze whether respondents think it is a problem that valuation is based on these two preconditions, since this can lead to the problem of neglecting environmental problems. The answers that came up were pretty diverse. Interviewee number 1 calls for a prudent approach to tackle this problem. A precautionary approach was also promoted by interviewee number 4, who also stated that decisions should be more based on scientific knowledge. According to this interviewee scientists have more knowledge about the interconnections and dynamics of the ecosystem and are thus more able to estimate the value of things. The interviewee excluded values that are based on people's perception like amenity of a landscape. Interviewee number 3 also pointed out that the knowledge base has to be improved to improve decisions. Interviewee number 9, in contrast, stated that our understanding of utility has to be changed. That the problem can be solved by using the proper valuation methods was stated by interviewee number 8. Finally, interviewee number 7 pointed out that it is impossible to protect something that we do not know.

As a sub-question I wanted to know if it would be possible as a solution to the aforementioned problem to generally include the environment in our considerations, apart from our knowledge and perception. Respondent number 2 confirmed the afore-made statement and again indicated the regulating and protecting function of governments. Similarly, interviewee number 1 again pointed out the importance of a prudent approach. “The imperative should be to reduce our footprint on nature, irrespective of what we know.” Respondent number 4 called for the application of a

systems approach. “Things we do that hurt the environment in the end also hurt us. If you understand these interconnections, just the recognition that natural capital is more than just a pretty picture, that it is something we absolutely depend on, that would be a step in the right direction.” A different argument was that not having an anthropocentric point of view is impossible. Interviewee number 3, for example, promotes a utilitarian approach, because humans protect what is of use to them. Also, interviewee number 7 stated that it is practically impossible and interviewee number 9 answered in a similar manner. “Theoretically yes, but as a society we are doomed to understand things anthropocentrically.”

The commonalities concerning this last question and sub-question can be found in the promotion to broaden knowledge and to use this as base for decision making. Another is to follow a precautionary or prudential approach. The accordance of the sub-question lies in the negation of the possibility not to follow an anthropocentric point of view.

20. Discussion

After finding similarities and differences in the statements of the interviewees, I finally tried to assign the statements to one of the economic schools of thought. So first the question is if this is possible; second, if so, does one school of thought dominate? Concluding from part I of this thesis if people strictly adhere to one of the economic schools of thought, cooperation might be difficult. Hence the result of this analysis may give some information concerning tensions and agreements within the ELD initiative.

The first question, besides serving as an opener, was aimed at getting answers which reveal whether respondents follow the strong or the weak sustainability concept. Environmental economists would use the weak and ecological economists the strong sustainability concept. Since the first question was only an opener I only got very diverse and vague answers. Therefore the sub-questions expanding on the different kinds of capital and their substitutability should give a clearer picture. Starting from question number 1, it can be stated that there is no hardliner pursuing either weak or strong sustainability. It has to be stated that categorizing people's statements is a tricky task, since their answers were not always that explicit. Anyway, according to the sub-questions respondents numbers 1, 3, 4, 5, 7 and 9 put a little more emphasis on the complementary feature of stocks, pointing out that ultimately nature is an essential stock that we should not draw down at any cost. These five respondents would thus be categorized as ecological economists. On the other hand, we have interviewees numbers 2, 6 and 8, who did not emphasize the limits of substitution that much. Accordingly, these three would be ecological economists and

we would receive a ratio of 6:3.

Concerning question number two and the ranking made, it is again difficult to make a clear distinction. Regarding technology, it can be assumed that those who promote technology are rather on the *Environmental Economics* side and those who do not emphasize the role of technology too much follow an *Ecological Economics* point of view. If we follow this differentiation, respondents numbers 1, 2, 3, 5 and 8 follow the former and numbers 4, 6, 7, and 9 the latter school of thought. Hence the ratio is 5:4, while the technology promoters dominate only slightly with one vote.

Population growth gives a clearer picture. Ecological economists would have a high or relative high focus on controlling population numbers. However, there are 7 respondents (1, 2, 3, 5, 6, 7 and 8) who do not focus on that issue. Following from this, the majority would be environmental economists.

The message of the ranking of option c) changed production and consumption patterns is not that clear cut, although 8 respondents gave it a high ranking. The interesting point is the reasoning for that ranking. Those who focus on the efficiency side of option c) can be assigned as being environmental economists, in contrast to those who focus on the behavioral side, which is more *Ecological Economics*. If this assumption is true we again have a very narrow majority on the Environmental Economics side (2, 3, 6, 7 and 8).

And last but not least is option d) fostering economic growth. The ranking alone does not tell too much, and the reasoning sometimes makes a categorization even more complicated. Respondent number 6, for example, who put option d) first, did so only for pragmatic reasons. The respondent's reasoning did not tell much about the respondent's own perception but rather about a realistic world view. In contrast two mentioned an EKC relation. These respondents would be clear representatives of *Environmental Economics* even though one of the respondents using the EKC argument put option d) only in third place. Moreover, there are respondents who stated that options a) and c) promote economic growth. So they did not rank d) first because they do not perceive it as being that important for sustainability – which the other two options, in contrast, are. Nevertheless, the respondents still pointed out the importance of growth, whether regarding poverty reduction or job creation. On the other hand, there are those who gave economic growth a low ranking, pointing out the necessity to rethink human understanding of wellbeing. These people could be categorized as being ecological economists. If one tries to categorize the statements we would have respondents numbers 1, 2, 4, 5, 8 and 9 on the *Ecological Economics* and 3, 7 and 8 on the *Environmental Economics* side. Still, one does not get a clear picture in which pigeonhole to put

single respondents. For example, respondent number 1 is against the economic growth fixation, emphasized the need to shift toward economic development and promoted the idea of sufficiency. On the other hand this respondent pointed out that technology and changed production and consumption patterns will promote economic growth. And as already pointed out, respondent number 6 can also not be categorized.

Questions numbers 4 and 5 inquired about the sufficiency and adequacy of indicators and / or indices to measure economic progress and human quality of life. All stated that GDP is not a sufficient indicator to measure economic progress, since it leaves many blind spots and thus delivers a biased picture of the economy's state. All agreed that other factors should be included as well, like those that are connected to natural stocks or to subjective indicators measuring, for example, happiness. This unanimity illustrates the beyond GDP debate, which was explored in part I of this thesis. The beyond GDP debate is a unifying issue. The only difference is to what extent people still focus on GDP alone. In this case none of the respondents is of the opinion that economic growth is more important than human development. Only 4 stated that they are equally important, while two added that this is only the case assuming a different understanding of economic growth. Regarding this set of questions it can be concluded that again both schools of thought are represented. Those who argue that they are equally important can be both. It would be necessary to further investigate the respondents' understanding of a "different understanding of economic growth". One respondent, for example, stated that they are equally important since there are different stages of development where quantity (growth) and when a shift to quality (development) are necessary. This is very similar to Herman E. Daly's idea of a steady state economy. This respondent would be thus categorized as an ecological economist. Since these questions and sub-questions did not deliver answers that allow a categorization, they are excluded from this step.

Question number 6 investigated the respondents' understanding of green economy. Similarly to the questions analyzed above, both schools of thought can be differentiated through the emphasis on economic growth. Only two used the word economic growth. One used economic development and another one only economy. Two others pointed out the negative aspects of this concept. Those two who mentioned economic growth would be among the representatives of *Environmental Economics*, while at least 3 of the respondents belong to the other school of thought. Anyway, I also exclude this question since only five respondents could be categorized to one of the schools of thought.

The next question again required the respondents to rank three options. Those who follow the

Environmental Economics perception would rank allocation first and those who follow *Ecological Economics* thinking would rank scale first. Figure 37 shows that both schools of thought are represented nearly equally, while scale (4, 5, 6, 7 and 9) outpaces allocation (1, 2, 3 and 8) by one vote.

The goal of question number 8 was finding out to what extent respondents believe in the power of internalization. Those who believe in it can be identified as following *Environmental Economics* and those who do not put that much trust in this method are ecological economists. Although none of the interviewees think that internalization is the solution, those who emphasized the role of internalization could still be classified as environmental economists (1, 2, 3, and 8). Thus we have a ratio of 5:4 for the ecological economists.

Question number 9 dealt with CBA and its limitations. While it seems to be the predominant opinion that CBA is better than doing nothing, only 4 would also support using other methods. Following what was examined in part I, those who also support other methods that do not only capture monetary value would be part of the *Ecological Economics* school of thought (1, 3, 4, 5 and 9) and those who cannot be categorized as environmental economists (2, 6, 8). Respondent number 7 makes the usage of methods dependent on the stakeholders involved and thus cannot be categorized.

The last question was concerned with the intrinsic value of the environment. Theoretically, those believing and respecting the intrinsic value follow the *Ecological Economics* perception. In this interview no one really stated that intrinsic value should be generally incorporated in the process of decision making, other than applying a precautionary or prudential approach. Hence according to these answers no one would be categorized as an ecological economist. Apart from that, the answers are hard to categorize. Governmental intervention, which was supported by one interviewee, cannot be categorized as either-or. *Environmental* as well as *Ecological Economics* do promote governmental intervention, even though to a different degree.

The questions that delivered a categorization are illustrated in table 3, also showing the respondent's number. According this table, Figure 39 depicts the result of the interview.

Question number	Ecological economist	Environmental Economist
1	1, 3, 4, 5, 7, 9	2, 6, 8
2 (a)	4, 7, 6, 9	1, 2, 3, 5, 8
2 (b)	4,9	1, 2, 3, 5, 6, 7, 8
2 (c)	1, 4, 5, 9	2, 3, 6, 7, 8
2 (d)	1, 2, 4, 5, 8, 9	3, 6, 7
7	4, 5, 6, 7, 9	1, 2, 3, 8
8	4, 5, 6, 7, 9	1, 2, 3, 8

Table 3: Classification of answers

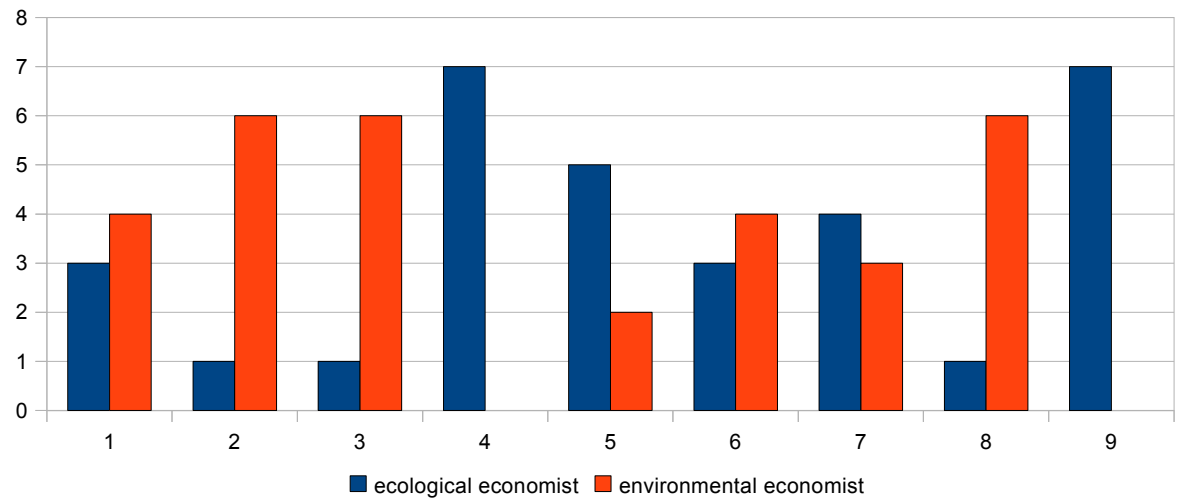


Figure 39: Classification of answers

Figure number 39 shows that according to the results of the analysis of the interviews, only one respondent exclusively gave answers in accordance with *Ecological Economics.* Another four are environmental economists. Respondents numbers 2 , 3 and 8 are clearly characterized, number 1 and 6 in contrast deliver a close run. On the *Ecological Economics* side one can add numbers 5 and 7, while number 7 exhibits a similar pattern as number 1 but the other way round.Thus the final share is 5:4 for environmental economists.

It has to be pointed out that this is just a very small sample of nine people who contributed to the initiative. Hence this is not a comprehensive analysis from which significant conclusions can be drawn. Even if the result is relatively balanced it is first, not clear which opinion others have that were not included in the sample and second, how much influence each of the participants has within ELD.

However, concerning my research question it can be stated that there are six respondents who rather clearly follow one of the schools of thought. Particularly interesting are those respondents who do not deliver such a clear picture. They seem to take elements from both schools of thought. Probably these people are an example that the gap between both is not that insurmountable. And if one takes a closer look at questions that were eliminated in the final stage of analysis one finds that also respondent number 4 at least once answered deviating from the *Ecological Economics* point of view.

The positive thing about this result is that there is probably much space for dialogue. Both schools of thought are represented and some respondents seem to combine both stances. Both want to reduce humans' harmful impact on the environment; both schools acknowledge (even if they do to a different degree) the great importance of the environment to promote human wellbeing; both schools have different perceptions and methods to offer. A collaboration of both could allow taking the best of both worlds.

For future collaboration it would still be important to talk about the different understandings and assumptions. The importance of economic growth should be discussed. This discussion would be related to issues of how to measure wellbeing and how to communicate this to policymakers and the private sector. Moreover, it is related to the green economy debate and how ELD will position itself. The major issue is in how far changed production and consumption patterns only entail a shift to greener sectors, or whether it also means a reduction and a shift toward quality. Another related issue is the assessment and figure of value on the micro-level. Some respondents were open to also promote and use other methods than CBA.

It is clear that not taking the mainstream neoliberal market based approach is probably not the best way to get the attention of a broad audience. Still, it should be discussed whether using methods which bring along many shortcomings is the right approach in the long run. My interviews revealed that the behavioral part of changed production and consumption patterns is quite important. Moreover, one respondent emphasized and the ELD publications (ELD 2013:44) also indicate the importance of education. Hence, probably one future issue is to focus more on education in order to promote the behavioral shift. One respondent pointed out that humans were once aware of the value of nature, but that since people are more and more detached from nature they lost this knowledge. The goal is now to re-awaken this knowledge.

If education is that important and if the monetary valuation is only used as a communicator to make people understand that we should not waste our planetary resources, then the question remains

how ELD will do this educational task. Most of my respondents seem to use monetary valuation as a communicator and they as scientists do know that there are many things that cannot really be assigned a monetary value and / or that often these values are only an approximation to the “real” value. But do the ones who make decisions know that? Are people who use CBA aware of the fact that these values are not real, that they are only a place holder that tries to give an idea about the “true” value? Is ELD informing people that the assets on which human survival is ultimately based are environmental assets? All other forms of capital can only work if the natural capital stock is big enough to support the other capital stocks. Human beings and the capital they embody, as well as all kinds of man-made capital, need maintenance, and the resources for maintenance come from the natural capital stock. Probably it is not the task of ELD to do this educational and informational work. Anyway, if one really wants to make understandable that we have to value and appreciate our environment it has to first be checked what information or meaning is transported using the monetary indicator and second, if we probably have to change our epistemological frame. The accepted means of communication might not be the best means of communication. Thus using monetary valuation and CBA as the only means of communication just to be heard might be the wrong approach. Getting heard and communicating the wrong information might be very harmful, even if it was intended to help.

21. Conclusion

Humans' negative impact on nature has reached an unprecedented stage. It has reached a stage where the negative effects on the environment more and more have negative effects on humans themselves. In order to stop this process, action is urgently needed. Humans need to minimize or stop wherever possible their harmful actions in order to allow nature to sustain humanity. Various approaches exist that give possible pathways and solutions to the pressing environmental problems. In this thesis two pathways offered by two different economic schools of thought were discussed. *Environmental* and *Ecological Economics* both provide us with ideas on how to tackle the problem. They give two possibilities to understand how nature and humans are connected, to what extent this relationship is featured by dependencies and hence to what extent environmental problems are negligible. They are based on two entirely different preanalytic visions, which shape the whole school of thought, the lens through which world is seen, understood and analyzed. Departing from these two understandings, different approaches to solve environmental problems are offered.

Environmental Economics is based on the market mechanism, which is seen as a regulating mechanism, where people communicate their preferences though their purchase decisions. Explicitly attaching value to the environment allows people to integrate the environment in their decisions, which in turn should increase environmental protection and decrease environmental destruction. Although *Environmental Economics* goes a step further than neoliberal theory by including the environment in the considerations, this school of thought still does not emphasize the limits to economic growth dictated by the limits of the environment to allow and sustain human existence. Rather, it is assumed that the economy can grow green, which means that a shift to less environmentally harmful economic activities allows unlimited economic growth while being in accordance with environmental protection.

Ecological Economics, in contrast, is based on this very notion of limits determined by nature and humans' absolute dependence on nature's capacities. Thus this school of thought does not leave the protection of the environment to the market system, but calls for governmental intervention in the first place. For *Ecological Economics* it is clear that before any allocation of commodities should take place it has to be assured that humans' appropriation of environmental commodities does not overshoot environmental capacities. Hence *Ecological Economics* challenges the unlimited growth paradigm, pointing to the biophysical conditions humans live in.

The analysis of both schools of thought showed that there does not seem to be much common ground. The only communality is the goal, to protect the environment and internalization of environmental commodities. It was pointed out that the reason for doing so differs completely, since *Ecological Economics,* for example, contests the commensurability of values and generally emphasizes the ethical problems connected to internalization. However, this school of thought uses internalization as a last opportunity to attract peoples' attention and bring the message across. *Environmental Economics* uses this method also to communicate. But in contrast, here it is used to catch information which was ignored or forgotten so far.

One might think that as long as they have the same goal and use the same method, it might not matter which of the schools of thought is followed for policy implementations. UNEP's green economy concepts show that this is not the case. Underlying assumptions have a massive influence on policies, like the promotion or dismissal of the growth paradigm. Anyway, the commonalities allow the collaboration between the two schools of thought, which is illustrated through the ELD initiative. Despite all the differences, representatives of both schools of thought can work together in a constructive way. It has to be pointed out that this is only possible as long

as endeavors deal with making people understand the value of the environment. As soon as the issue of limits to growth comes in, two completely distinct schools of thought face each other. UNEP's green economy concept, its evolution, illustrates that on the policy level a concept is either following *Environmental* or *Ecological Economics,* but not a combination of both.

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APPENDIX I

Questions of the semi-structured interview with ELD key contributors

1. What is sustainability for you?
   1.1. There are different perceptions or viewpoints of sustainability. One is that we consider an aggregate stock which is comprised of two other stocks, that are natural and man-made capital stock. To what extent do you think that man-made capital, like financial capital or intellectual capital, and natural capital, like resource stocks, are substitutes? Are they interchangeable or are they complements?
   1.2. Some say that sustainability is given as long as the aggregate stock keeps stable, no matter how the two components of that aggregate stock fluctuate. Or would you rather say that the single stock components manmade and natural capital have to keep stable in order to fulfill sustainability?
   1.3. What role does the preservation of the present stock of natural capital play for sustainability?
   1.4. Do you evaluate the importance of keeping the stock of natural and man-made capital as equally important for sustainability?
2. Would you please rank the following terms / concepts in descending order from the most important term to the least important term regarding sustainability (sustainable development)
   a) investment in technology in order to promote sustainability
   b) controlling the population number in order to allow sustainability
   c) changed production and consumption patterns in order to permit sustainability
   d) fostering economic growth in order to facilitate sustainability
   2.1. You chose ____ as most important; why?
   2.2. You ordered ____ second; why?
   2.3. You ordered ____ third; why?
   2.4. You chose ____ as least important; why?
3. Do you think GDP (Gross Domestic Product) is an adequate indicator for economic progress?
   3.1. Would you say that economic growth is equally important for developing as for developed countries? Please tell me why.
   3.2. Some say that in order to keep the economy within sustainable limits, economic growth should be limited to developing countries, or at least that they have priority to grow. What do you think about this?
4. In contrast to GDP, there are also indices that measure not only economic growth but also include social factors. One is, for example, the HDI. Do you think that Human Development Index, an indicator measuring literacy, life expectancy, and economic growth, is an adequate indicator for human quality of life and human development?
   4.1. Would you say that development is equally important for developing as well as for developed countries? Please tell me why.
5. Are human development and economic growth interconnected?
   5.1. Some say that only economic growth facilitates development. Or would you say that

development is independent on economic growth? What is your opinion?

5.2. Do you think economic growth and development are equally important for sustainability?

6. How would you define green economy? What is your understanding of this concept? And how is it related to sustainability? Are they related? In which way? If not, why not?
7. Would you rank the following concepts descending from the most important term to the least important term regarding sustainability?
   a) Appropriate Scale: the aggregate size of the economy in relation to the size of the ecosystem or in relation to the natural resources available.
   b) Fair distribution: the fair distribution of goods and services throughout the global population.
   c) Efficient Allocation: the efficient allocation of production factors and commodities between the global population.

   7.1. You chose _____ as most important; why?

   7.2. You ranked _____ second most important; why?

   7.3. You chose _____ as least important; why?

   7.4. What do you think about introducing an upper limit for the use of natural resources for sustainability?

   7.5. Do you think that the allocation function of the market system is adequate to facilitate a proper level of natural resource use in order to permit sustainability?
8. Some economists say that environmental problems occur due to market failure / missing markets. Therefore their approach is to integrate the external environmental goods and services into the market system in order to get the problem solved. What do you think about this approach? Can environmental problems be solved through this method? Yes / No … Why? (Examples are carbon trading, environmental damage due to production)

   8.1. Do you think that the market system has certain limitations and hence cannot solve environmental problems alone? (Limitations: market distortions, through governmental interventions, or because they are not perfectly completive. Or concerning the attachment of monetary value to non-market goods, there are also no objective prices, prices depend, e.g., on the method used)
9. Cost-Benefit Analysis is a commonly used method to compare investments. To include natural resources or generally the environment into these calculations, a monetary value needs to be attached to them. Some say that it is not possible to put a monetary value on the environment. What do you think about this?

   9.1. If there are certain problems or limitations concerning attaching monetary value to natural commodities, do you think it is adequate to draw conclusions for implementation from those analyses and calculations? Is it still useful, do they reflect reality and are they really a good basis to make decisions?

   9.2. Do you know alternatives to Cost-Benefit Alternative or Cost-Efficient Analysis? I mean alternatives that probably do not only include monetary values for comparison. If not, do you promote finding alternatives that probably better reflect the value of the environment?

10. For environmental commodities to be included in economic considerations two factors need to be fulfilled: Utility to humans and perceived relative scarcity are preconditions for environmental goods to be included in economic analysis. These two conditions are based on subjectivity, hence the perception of utility; as long as something is not perceived to be useful it is excluded. Another condition is knowledge; as long as humans don't have knowledge about relative scarcity, they are also excluded (e.g., ozone layer). What do you think about the problem that this inclusion is dependent on human's knowledge and attitude (needs)?
    10.1. Is this enough or should the environment be generally be included, independent from human knowledge and attitude? Valuing nature for its intrinsic value and not merely for their utility to humans?

APPENDIX II

Abstract

Today people all over the planet are faced with ever-increasing environmental problems. It is acknowledged that society is to a large extent responsible for causing these problems. Environmental destruction has reached an unprecedented dimension which severely threatens human wellbeing and survival. Therefore many approaches exist that try to tackle these problems. One approach is to illustrate which positive and negative effects environmental degradation has on human wellbeing. This can be done employing different indicators. For example, biophysical indicators can illustrate the reduction of biophysical stocks and thus conclusions can be drawn from this data as to how this process influences human wellbeing. Another possibility is to interpret changes of the environment economically, attaching a monetary value to them. These two approaches are used by two different economic schools of thought, *Environmental* and *Ecological Economics*. *Ecological Economics* is based on biophysical considerations and *Environmental Economics* on the market system and neoliberal economics. These two schools of thought are usually seen as following and engaging opposing approaches.

In this thesis I give an overview of both schools of thought, starting with a short discussion of the respective intellectual fathers and the preanalytic vision they are based on. Underlying concepts are discussed and methods which are employed by each school of thought are introduced. The aim of this comparison is to find out whether there are only differences or whether there are also similarities or uniting aspects. Both schools of thought influenced the formation of *United Nations Environment Program's* (UNEP) concept of Green Economy; thus, I analyzed UNEP's Green Economy concept in illustrating how both schools of thought influenced it and how these opposing schools of thought influence reality.

From a theoretical standpoint one can conclude that both schools of thought are completely separate from each other. The only commonality one can find is the ultimate goal, reducing environmental destruction, and the employment of monetary valuation. Although *Ecological Economics* is based on biophysical reality, some representatives still use monetary valuation as a means of communication.

These unifying factors permit both schools of thought to work together. One initiative that illustrates this is *Economics of Land Degradation* (ELD), which is discussed in part II of this thesis. Similarly to UNEP's Green Economy concept I tried to find out whether ELD follows *Environmental* or *Ecological Economics*, in order to draw conclusions for real world implications.

Methodologically this research was based on literature review and on expert interviews of nine key contributors to that initiative. This small sample does indeed not allow a final statement to be made about ELD. However, I could find out that among these nine contributors the affiliation to one of the two analyzed schools of thought is balanced. Moreover, some respondents seem to take ideas from both schools of thought. Thus, overall I concluded that although there are great differences separating both schools of thought, there are two factors which are strong enough to unite them on the level of implementation and policy recommendation: the same goal and the employment of monetary valuation.

Zusammenfassung

Heutzutage sind Menschen überall auf der Welt mit gravierenden Umweltproblemen konfrontiert. Inzwischen ist es mehr oder weniger anerkannt, dass der Mensch selbst für diese Probleme verantwortlich ist. Umweltzerstörung hat ein noch nie da gewesenes Ausmaß angenommen, welches das Wohlergehen und das Überleben der Menschheit bedroht. Daher gibt es eine Vielzahl an Lösungsansätzen um die gegenwärtigen Umweltprobleme zu mindern. Eine Möglichkeit ist es positive und negative Effekte der Umweltzerstörung aufzuzeigen. Dies kann durch die Verwendung verschiedener Indikatoren geschehen. So kann man zu Beispiel biophysikalische Indikatoren verwenden, um den Verlust des biophysikalischen Bestandes zu zeigen. Auf Grundlage solcher Daten können in der Folge Rückschlüsse auf Effekte auf das menschliche Wohl gezogen werden. Ein anderer Ansatz ist es diese Veränderungen ökonomisch zu betrachten, indem man ihnen einen Geldwert zuordnet. Diese zwei Ansätze werden von zwei verschiedenen ökonomischen Strömungen angewandt; Umweltökonomie und Ökologische Ökonomie.

Umweltökonomie basiert auf dem Neoliberalismus, Ökologische Ökonomie hingegen auf der biophysikalischen Realität. Beide Ansätze werden generell als einander entgegengesetzt wahrgenommen. Diese Diplomarbeit liefert einen Überblick über beide Denkschulen. Die Gegenüberstellung beginnt mit einer Darstellung der geistigen Väter und der präanalytischen Visionen, die ihnen unterliegt. Weiters werden grundlegende Konzepte angeführt und Methoden, die die jeweilige Denkschule anwendet, vorgestellt. Das Ziel dieser Arbeit ist es herauszufinden, ob es auch einende Faktoren gibt oder, ob nichts die beiden Denkschulen verbindet. Beide Schulen haben die Entstehung des Konzeptes der Grünen Ökonomie des Umweltprogramms der Vereinten Nationen (UNEP) beeinflusst. Folglich habe ich das Konzept der Grünen Ökonomie des UNEP's analysiert, um zu zeigen wie sich dieser Einfluss in der Realität auswirkt.

Aus einer rein theoretischen Sicht kann man schlussfolgern, dass beide Denkschulen komplett

voneinander getrennt sind. Die einzige Gemeinsamkeit lässt sich im gemeinsamen Ziel, der Reduktion von Umweltzerstörung, finden. Außerdem greifen beide auf das Werkzeug der Internalisierung zurück. Obwohl die Ökologische Ökonomie auf der biophysikalischen Realität basiert, verwenden einige Vertreter die Internalisierung zwecks Kommunikation.

Dieser einende Faktor erlaubt es beiden Denkschulen miteinander zusammenzuarbeiten. Eine Initiative die das zeigt, ist *Economics of Land Degradation* (ELD), welche im zweiten Teil der Arbeit behandelt wird. Ähnlich wie bei UNEP's Konzept der Grünen Ökonomie habe ich versucht herauszufinden welcher der beiden Denkschulen ELD zuzuordnen ist. Daraus können Schlussfolgerungen über die Arbeit und Strategien der Initiative gezogen werden.

Methodologisch war diese Untersuchung auf Literaturrecherche sowie auf Experteninterviews gegründet. Neun Experten, die maßgeblich an der Initiative beteiligt waren, wurden befragt. Natürlich ist diese Stichprobe zu klein um eine endgültige Aussage treffen zu können. Allerdings konnte ich zeigen, dass beide Denkschulen fast gleich stark vertreten sind. Außerdem scheinen einige Experten von jeder Schule bestimmte Ansichten anzunehmen. Daher kann abschließend gesagt werden, dass alles in allem zwei starke Faktoren existieren, die beide Denkschulen miteinander verbinden; das selbe Ziel und die Verwendung der Methode der Internalisierung.

APPENDIX III

Curriculum Vitae

Katharina Biely

Education

Academic studies

since March 2008 International Development at the University of Vienna

2007 – 2008 Environmental Engineering at the University of Natural Resources and Life Sciences, Vienna

Schooling

15. 03. 2007 Externistenreifeprüfung – graduation diploma passed with distinction

Professional experience

2012 Internship for 240 working hours at the Institute of Social Ecology (SEC), IFF - Faculty of Interdisciplinary Studies, Alpen Adria University

since 2010 Climbing trainer at the Austrian Alpine Club (OEAV)

2007 – 2010 Voluntary activities at the Austrian Alpine Club (OEAV)

2009 Two month internship at Scort Foundation

2007 – 2009 Insignificant employment at Sportwareneinzelhandel Heinz Heger – retail for sporting goods

Language skills

German	Mother tongue
Italian	B2 (according to Common European Framework of Reference for Languages)l
English	IELTS 8
Spanish	B1
Hindi	A1