Towards a ‘new’ political arithmetic

An assessment of the indicators of sustainable development

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Tiivistelmä – Referat – Abstract

This study examines the urge to construct indicators of sustainable development that has been outlined in the Agenda 21 of the Rio Earth Summit 1992, re-expressed in the Rio+20 Declaration "The Future We Want" in 2012, and discussed in the work by the Commission on the Measurement of Economic Performance and Social Progress (2009). An indicator of sustainable development (SDI) is a measure expected to signal whether a society is on a sustainable path, or not, by organising large data sets into easily readable illustrations for the purposes of policy-makers. The study positions into the earlier work of sociologists of science and philosophers such as Hacking and Latour who have aimed to understand the contexts in which knowledge is formed. For policy-makers and the wider public, understanding the limitations of these different measurement approaches can be beneficial.

This study suggests that SDIs can be considered analogous to evidence-based autonomous models that can be framed in various ways. One-dimensional indicators select a single bottom-line against which other considerations are judged; composite SDIs typically aim to balance environmental, social and economic considerations; and monetary-based indicators attempt to incorporate ecological and social losses into economic costs. Depending on the choice of approach, a SDI may either adhere to the principle of 'strong sustainability' according to which no ecological harm is acceptable, or 'weak sustainability' that accepts substitutability between different types of capital, including the loss of natural capital. However, a general weakness of several SDIs has been their inability to signal when ecological thresholds are crossed.

Under energy and resource constraints, these efforts reflect an aspiration, borrowing the terms of seventeenth century political economists, the need to explore means towards a 'new' political arithmetic. This study aims to observe what choices researchers and political institutions have and have made in adapting to the realities of climate change and other ecological constraints. The study will argue that the depiction of 'sustainable development' may be a worthy ideal but for measurement purposes of actual ecological or social thresholds, a notion of multiple meanings has challenged the work of scientists who have been unable to agree over a 'proper' indicator. By assessing the theoretical underpinnings of science, the aim of this study is provide common ground to the multidisciplinary subject matter of sustainability for natural and social scientists who often conduct research in their separate research strands. Furthermore, scientific work itself follows societal progress and is limited by theoretical underpinnings that inevitably also influence the attempts to construct meaningful indicators.

The study observes how in the context of political decision-making, institutions that act as gatekeepers that shape the understanding of politicians about the choices they have, even if these institutions are constrained by ideological discourses as well as existing institutional arrangements. For the purpose of the measurement of sustainable development, existing cross-country measures such as the GDP have serious weaknesses. At least in the advanced economies, while the measurement of aggregate economic growth may remain useful, it may be less relevant than it was in the contexts of modernisation and post-Second World War reconstruction when the current UN System of National Accounts was adopted. However, pragmatic challenges also undermine some of the alternative indicators, including the lack of available data as well as the need for institutional capacity and improved theoretical understanding about sustainability. Nevertheless, it is suggested that states could engage more closely to explore the possibility to use SDIs as a new technology of governance. For this purpose, the study also examines indicators of climate change, material flows and energy. It is also suggested that decision-makers may need to better adopt a perspective of systemic thinking that adopts an ecological view that also internalises social considerations rather than macroeconomic theories that treat ecological and social costs as externalities.

Avainsanat – Nyckelord – Keywords
accounting, climate change, economics, energy consumption, indicators, planetary boundaries, quantification, SDIs, sociology of science, sustainable development

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Abbreviations

Agenda 21	Action plan to Sustainable Development (agreed in the 1992 Rio Earth Summit)
BP	British Petroleum / Beyond Petroleum
CDIAC	Carbon Dioxide Information Analysis Center (U.S. Department of Energy)
CBD	Convention on Biological Diversity
CBDR	Common but differentiated responsibilities
COP-15	Copenhagen Climate Change Conference (2009); The 15th Conference of the Parties
CSR/CSER	Corporate responsibility (including social and environmental responsibility)
DFID	Department for International Development (Government of the United Kingdom)
EU	European Union
FDI	Foreign direct investment
IEA	International Energy Agency
IFIs	International financial institutions, typically IMF and the World Bank
IISD	International Institute for Sustainable Development
ILO	International Labour Organization
IGO	Intergovernmental organisation
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ITUC	International Trade Union Confederation
IUCN	International Union for Conversation of Nature
LDCs	Least developed countries
MDGs	Millennium Development Goals
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NEF	New Economics Foundation
NGO	Non-governmental organisation
ODA	Official development aid
OECD	Organisation for Economic Co-operation and Development
REN21	Renewable Energy Policy Network for the 21st Century
Rio+20	United Nations Conference on Sustainable Development; also UNCSD (2012)
SAP	Structural adjustment programme
SDI	Indicator of sustainable development
SDGs	Sustainable Development Goals
UN	United Nations
UNCED	United Nations Conference on Environment and Development; Earth Summit (1992)
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNRISD	United Nations Research Institute for Social Development
WB	World Bank
WDI	World Development Indicators
WDR	World Development Report
WHO	World Health Organisation
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development (2002)
WWF	World Wildlife Fund
ZSL	London Zoological Society

1. Introduction

An urge to construct indicators of sustainable development beyond economic growth was outlined in Agenda 21 (UN 1993, 473–479) already 20 years ago in the original Rio Earth Summit, and is re-expressed in the paragraph 38 of the Rio+20 Declaration: "The Future We Want" in 2012. An indicator of sustainable development (SDI) is a measure that is expected to signal whether a society is on a sustainable path, or not. SDIs are evidence-based 'autonomous models' (Morgan and Morrison 1999) of economic, social and/or environmental performance, usually for policy-makers in national or sub-national level that organise large data sets into easily readable illustrations. One-dimensional indicators select a single bottom-line against which other considerations are judged. Composite SDIs are indices built upon the triple-bottom line theory of sustainable development to balance economic, environmental and social considerations. Monetary-based indicators attempt to expose ecological and social losses and convert them into economic costs. In environmental studies, indicators that describe human pressures on ecology have been preferred and also resource efficiency has been studied. Different approaches provide different types of framings that may alter the perception and the consequent problem evaluation.

Over the years in the academia, there has been active debate about the indicators of sustainable development (e.g. Hueting 2013; Sciubba 2013; Galli et al. 2012; Mayer 2008; Talberth 2008; Lenzen et al. 2007; Dietz et al. 2007; Böhringer and Jochem 2006; Lawn 2006, 2003; Neumayer 2003, 2000; Booysen 2002; Daly and Cobb 1989). Bottom-lines express moral considerations and ideological stances, and therefore numbers are an efficient way to describe the state of our societies. The context of this study lies in the contemporary debates of international politics and addresses the viewpoints of ecological sustainability and social equity. After all, international politics and the state of the global society are the real-life foundation against which the theory of sustainable development and the evolution of measurement techniques should be tested. In particular, this study attempts to reflect SDIs vis-à-vis the bottom-line of climate change. If a selected indicator was promoted more actively to support policy-making, would that indicator respond to the need to govern anthropogenic climate change now considered to advance beyond +2.4°C–6.4°C – more rapidly (IPCC 2013; NOAA-Scripps 2013; IEA 2013, 2011b; McKibben 2012; Anderson and Bows 2008) than the earlier worst-case scientific scenarios (IPCC 2007)?

The research proceeds with the employment of four hypotheses. First of all, the study will argue that while the depiction of 'sustainable development' may be an ideal worthy of support, for the

purposes of understanding what actually *is* sustainable such a transformational notion of multiple meanings is problematic as it struggles to provide a single operational definition. And for this reason, scientists might have had it difficult to find consensus over a 'proper' indicator or unit to measure sustainable development (H_1). Secondly, the paper will point out that science itself is an institution and that theoretical underpinnings inevitably influence the attempts to construct indicators as well as limit the availability of research choices. What is more, not only can certain discourses and rationales be argued to be more dominant than others, some of them enjoy a close proximity to the political decision-making system. Even if new scientific evidence continues to shape our understanding about and adapting to the world, I suggest that this symbiotic relationship of the economy and political institutions upholds the dominance of orthodox ways about how to conceptualise the world (H_2). My third argument, then, suggests that political institutions act as 'filters' between scientific information and political decision-making, and in their attempts to use scientific information, they are constrained or supported by ideological discourses as well as existing institutional mechanisms and their constitutional mandates. While obliged to follow their institutional logic, institutions also compete for attention and resources with other institutions. For these reasons, certain institutions have particular authority, which makes them gatekeepers that influence the political space in the international system as well as shape the understanding of politicians about the priority of policy choices (H_3). Following the claims, the study will finally claim that by framing the issue of sustainable development differently, it is possible to adopt a more realistic perspective about the current situation with regard to ecological thresholds, resource sustainability and climate change and that this can be conducted by looking at the roles of material flows and energy and their systemic contribution to economic growth and human well-being (H_4).

The study will argue that the philosophy, rationales, and logic of the indicators of sustainable development (SDIs) can be better understood in a historical context of science and international institutions. Because scientific information provides the basis of evidence-based policy-making, the research provides an investigation of scientifically determined bottom-lines that are employed in relation to sustainable development. The paper also notes how the increase in the documentation of statistical information has followed societal development and shaped the means and motives of policy-makers to govern. Because indicators are expected to have a communicative and an advisory role, to concretise these claims, the research will examine how different institutions that employ SDIs align with different theoretical underpinnings, and elaborate the measurement approaches and ideological stances of intergovernmental organisations (IGOs), non-governmental organisations (NGOs), think tanks and states to assess how SDIs are and could be used in a political context.

Because different influential political actors are able to use information according to their respective rationales, it is relevant to assess these approaches critically. This research thus suggests that although institutions may genuinely be seeking for 'green governmentality' (Bäckstrand and Lövbrand 2007, 126) as well as constructing SDIs in order to govern and tackle sustainability-related concerns, it is important to understand why these efforts may prosper or fail.

To cover this task requires an assessment of a large amount of data but is necessary in today's science where many contributions relevant to the multidisciplinary subject matter of sustainability occur in isolated silos (Neumayer 2010; Willamo 2005). Philosophers and sociologists of science rich in their conceptual analysis have focused less in the examination of the contemporary sustainability debate; administrative and organisational studies have studied the power of indicators in the national scope, and IR studies in the context of global governance, but both have had limited interest in the inclusion of the ecological component. This same problem, to an extent, manifests in the field of development studies that does study the ingredients of development, but has traditionally been occupied with issues of poverty and socio-economic development. Then again, the detailed work of statisticians who are able to provide detailed methodological assessments regarding measurement techniques may remain trivial unless they are better connected with the operational logic of the political system. Natural scientists, on the other hand, tend to have limited ability to connect their analysis with social science studies, of which the latter nonetheless has traditionally enjoyed high political and policy relevance. Then again sustainability scholars – if such exist – that aim for a holistic approach between these different components themselves might constitute one 'epistemic community' (Haas 1992).

For these reasons, and in relation to the urgent political need to better govern the commons (Ostrom 1990) the aim of this study is to deeper analyse the SDIs in order to provide common ground for natural and social scientists who far too often conduct research in their separate strands as well as policy-makers who struggle to understand the benefits and limitations of scientific information, while considering trade-offs between economic, social, environmental and other considerations. I hope that a compilation of field-specific bottom-lines that is accompanied with an illustration of the underlying assumptions of these measures can clarify some common misunderstandings with regard to what is labelled as sustainable, and the examination of resource consumption can provide further clarification. Unless the fundamental assumptions of indicators are not questioned (Erkkilä and Piironen 2009, 131), the messages conveyed by SDIs could be misleading in a political context.

Data have been collected from various sources through a desk research into the work of multilateral organisations and research institutions. The SDIs that are specifically discussed in this paper have been collected from multiple sources (see: p. 77-78). In turn, data have been gathered from the most reliable sources available, either from the statistical divisions of or official reports published by multilateral institutions such as the Organisation for Economic Co-operation and Development (OECD), the International Energy Agency (IEA), the European Union (EU), the United Nations (UN) and the World Bank (WB)[1] as well as environmental policy think tanks, NGOs and research institutions including the likes of the Global Footprint Network, London Zoological Society (ZSL), the World Wildlife Fund (WWF) or World Resources Institute (WRI). On natural resources, Material Flows online database has been a useful tool as well as the comprehensive work by Krausmann et al. (2009). Information regarding climate emission levels has been obtained from the Intergovernmental Panel for Climate Change (IPCC), CDIAC[2] and NOAA[3]. In his personal capacity and partly to broaden the scope of the study, the author has also attended Rio+20 – UN Conference for Sustainable Development in June 2012 in Rio de Janeiro, Brazil; and the UNEP Governing Council in Nairobi in February 2013.

The use of empirical evidence also enables a process of falsification, a test whether an individual SDI actually seems to instruct a path towards sustainable development. In the course of this study, it will become clear how SDIs are end results subject to philosophical consideration, scientific debate, institutional interests and politics. However, theoretical scientific debate should not be confused with political deliberation. A political view can provide a deeper understanding on *why* SDIs are being constructed; an assessment of the interests and limitations of different institutions to the measurement of sustainable development as well as the opportunities, dangers and fallacies that lie in this muddle. Within the scope of this study, it is not possible to discuss in detail international legal arrangements regarding sustainable development, the communicative aspects of the science-policy interface or study in-depth the national settings in which SDIs are implemented on. Rather, my aim is to paint the 'big picture' through a careful assessment of numbers as well as the theories they rely on. After all, the normative assumptions of indicators need to be made explicit (Erkkilä and Piironen 2009).

[1] OECD Statistics (http://stats.oecd.org/); IEA is an independent IGO of OECD member countries; UN Statistical Commission (http://data.un.org/); World Bank's World Development Indicators (http://data.worldbank.org) and The World Bank Little Green Data Book

[2] Carbon Dioxide Information Analysis Center (CDIAC) is the primary climate-change data and information analysis centre of the U.S. Department of Energy (DOE).

[3] The U.S. National Oceanic and Atmospheric Administration (NOAA)

The study will proceed with the help of the four hypotheses. Chapter 2 will discuss the sociology of science of numbers and argues why indicators can be viewed as analogous to scientific models. Furthermore, while indicators may be seen as a technology of global governance (Davis et al. 2011), information and knowledge are also subject to institutional interests and rationales. Chapter 3 scrutinises and examines the concept of sustainable development (H_1) in a historical context to exhibit the tensions that are inherent in the theory of sustainable development, in its measurement approaches as well as its relationship with the operating field of international politics. Chapter 4 provides a historical perspective to scientific endeavour and the construction of indicators (H_2) to suggest that the development of economic, social, environmental, developmental and happiness indicators has characteristically been motivated by contemporary societal development, and that this relationship is reciprocal. Chapter 5 discusses a selected group of 'indicators of sustainable development', employed by researchers, institutions (IGOs, NGOs, think tanks) and states, and examines the relationship of these indicators with the worldviews and motivations of these institutions and how they frame sustainability. It is argued that the global power relations related to information are highly asymmetric and the employment of numbers depends not only on analytical capacity, but how they are employed has to do with ideological stance of an institution. Chapter 6 elaborates the notion of rationality and the issue of framing (see: Kahneman 2011; Tversky and Kahneman 1981), which behavioural economists for long have known to affect our statistical judgment, through a discussion of energy and material consumption to illustrate how a re-framing of the entire indicator question can alter change perceptions to the theory of sustainable development and its indicator approaches. Therefore, sustainable development in itself forms a bounded rationality that may actually work *for* or *against* the ecological and social objectives of green governmentality but at least efficiently hides the issue of resource efficiency (H_4). To conclude, the paper summarises the pros and cons of different measurement approaches under the objective of sustainable development. Referring to the terminology of early political economists who studied the axis of state and capital, I argue that these efforts symbolise an aspiration towards a 'new' political arithmetic to govern nation-states that are currently ill-suited to meet the aspirations of sustainable development.

Finally, I should say a word of caution. While objectivity and positivism may have lost to the postmodern turn, I argue that in the middle of complexity it is critical to chart the dimensions we base our political decisions upon in order to understand and judge the everyday world around us. This paper studies the factors that influence evidence-based policy-making and thus may enable a better understanding of the processes that underpin information, which eventually becomes used by

the public. In the age of increasing transparency and availability of data, policy-makers and politicians need not anymore only to know where to find information, but they need to be able to employ their judgment what information to prioritise. Now, while some expect measurement techniques to improve and develop up to a point where they challenge the boundary conditions of human knowledge (Hacking 1990, 115) and even result in the improved management of sustainable development; others are more sceptical. These 'others' would suggest that meeting sustainability depends on choices within our material world – on the way people choose to lead their lives, which is something technocratic solutions may facilitate but eventually, it is people who need to make the choices. While I may have initially hoped to find a proper indicator to provide me with an answer, it is also a political decision of the international community to choose an indicator that is suitable for its needs. The different SDIs in all their richness make a conscious attempt to filter and manage the flux of information, and I hope that the conceptual understanding provided in this paper might advance enable the achievement of such an ambitious task to think anew – and to think again.

2. Scientific modelling, governance and institutional motives

2.1 Indicators and indices as scientific models

"Exhibiting principles of rationality applicable to individual reasoning is sufficient to demonstrate the rationality of science, at least in its ideal form."

(Longino 2011)

Social constructionism (Woolgar 1983, 466) views the scientific process through the role of scientists; actively constructing, rather than passively discovering facts of the world. Deconstructing the scientific endeavour can not only enable an understanding of science as an institution, but cast light to the efforts to measure sustainable development. Since the works of C.S. Peirce who pioneered in the theories of communications, Karl Popper's critical rationalism, and Thomas S. Kuhn's (1962) examinations of the structure of scientific revolutions; contemporary philosophers and sociologists of science have continued the examination of scientific paradigms and practice as well as reviewed the social aspects of scientific knowledge production. Ian Hacking (1999, 48) defines constructionism as sociological, historical and philosophical projects that aim at displaying or "analysing actual, historically situated, social interactions or causal routes that led to, or were involved in, the coming into being or establishing of some present entity of fact".

Hacking (1999) has attempted to bridge the gap between natural and social science approaches in order to explain that while the world is not a social construct, the conceptualisations that are produced and shared, evidently are. Hacking aims to contextualise knowledge and information in order to gain a critical understanding of our commonly shared terminology that shapes our social world. This underscores the necessity to take into account the history of facts in order to define the extent to which facts may be considered – factual. Hacking (ibid.) emphasises that even if our world is based on physical laws, social processes matter as well. Cartwright (1995, 138) writes that also scientific information is encoded in "our instruments, our mathematical techniques, our methods of approximation, the shape of our laboratories, and the pattern of industrial developments". While in the epistemological debate, realists have criticised constructionist views, in the spirit of "antirealism over realism" (Frigg and Hartmann 2012), Cartwright's aim has been to promote an instrumental view of science instead of what she considers a theory-laden construction of scientific knowledge.

The point that sociologists of scientists have attempted to bring forward is the understanding of how

in reality, scientific progress is achieved with trial and error (Pinch and Collins 1993, 142; Hacking 1983, 162-163). In the early 1970s, sociologists of science became interested in the construction of knowledge with the related philosophical questions, making the simple observation of viewing science also as a social endeavour (See: e.g. Longino 2011, Pickering 1992). In this due process, a number of different approaches also claimed their labels. In Edinburgh, the Strong Programme of the sociology of science (Barnes and Bloor 1982; Pickering 1984; Shapin 1985) examined large-scale social phenomena such as scientific controversies or political and social ideologies; under the Bath School, Collins (1985) critically examined the scientific endeavour but with a microsocial approach (see also: Pinch 1993, 2008); and Latour and Woolgar (1979) and Knorr-Cetina (1981) became known for the so-called 'laboratory approaches', in which using ethnographic methods they observed and described how science is actually produced (See also: Woolgar 1983). In addition, philosophers of science such as Ian Hacking, Nancy Cartwright, John Dupré and Peter Galison have all studied the construction and structures of knowledge, at times all labelled under the Stanford School; and Michel Callon and Bruno Latour (1992) have been named as the founders of the Paris school. In addition to ontological, epistemological, theoretical and semantic questions, also much more pragmatic questions have been in their interest. Sociologists of science have studied interdisciplinary issues and risk assessment as well as what type of science gets funded and what kind of science policy is conducted. In short, in thinking how science produces facts about the world (Howlett and Morgan 2010), sociologists of science have been successful in contextualising and humanising the scientific endeavour.

Hacking (1983) considers science to have two broad roles: *intervening* and *representing*. In terms of intervention, Carrier (2004, 276) notes that science is the first institution assumed to provide solutions to practical problems, with its reputation depending on its capacity to deliver. Kitcher (2001) even considers science that seeks the truth to be an ideal of science and that no distinction between theory and practice can be made. Carrier (2004, 290) considers purely theoretical interest "rarely dominant" in the history of science, suggesting that what essentially has driven science is knowledge useful for the betterment of the human condition. How information is presented has also concerned philosophers. Already Aristotle questioned how to *abstract*, that is, separate different representations from one another in order to find what is sought for (Frigg and Hartmann 2012; Mazur 2007) because the representation of a phenomenon can be produced in various ways. For us, examining the reasons of measuring societal development, these are interesting remarks.

An interesting recent development has been the increasing debate over the essence of scientific models that attempt to acquire information about the world in a pragmatic fashion. The construction of models and model-based reasoning (Oreskes and Belitz 2001; Morgan and Morrison 1999; see also: Frigg and Hartmann 2012) has become one of the principal instruments of modern science in various scientific contexts and across disciplines. Achinstein (1965) considered models as simplified approximations of the portrayed object, but Morrison (1999) rather sees models as 'autonomous agents' that have functional independence in knowledge production. Morrison and Morgan (1999) consider models as mediators, instruments to build theory. Fox Keller (2000, 74) describes models as theoretical entities which do not, however, constitute theory; they are 'go-betweens' between "the domain of theory" and "the domain of things". For Fox Keller (ibid., 77) the practical utility of models is that they are not merely metaphors, but may enable "doing as much as thinking". In this paper, I will consider indicators of sustainable development (SDIs) analogous to scientific models that may be assessed with relevant criteria. After all, Prasad (2004) considers modelling 'primordial' to the construction of indices and Hacking (1990, 1983) and C. S. Peirce have paid attention to the representative nature of models – in particular Peirce who has written about the communicative functions of icons. Duhem noted the task of scientists to work with a schematic model to make it understandable for the model user (Hacking 1999, 72).

Scientific models are often used in evidence-based policy-making **(**Oreskes and Belitz 2001). Models may be tailored in the aid of agencies and public institutions shaping public policy. Often, they are expected to provide predictive capacity, but Oreskes and Belitz (ibid., 25) emphasise that while these predictions are possible and even useful; public policy can and in reality often is conducted without them. Policy-makers have made policy forecasts, climate researchers have modelled the global climate system with Global Circulation Models (GCM); economists use numerous economic models; and in health policy, disease outbreaks are modelled in order to minimise casualties (Dahan Dalmenico 2007; Mansnerus 2011; Taylor and Buttel 1992). It is already over forty years, since the first integrated model of the world economy with the environment was conducted using a MIT-based World3 computer model that further gave birth to The Limits to Growth (1972).

Frigg and Hartmann (2012) have called for a systematic account of how models can relate to reality and the difference of models from theory in particular has been a point of debate. Cartwright (1983) explains that both models and theories may be inaccurate (Frigg and Hartmann 2012). Duhem (1954/1906, 155) explained that in terms of apparatus, the scientist manipulates the concrete

instrument, and a schematic model of the same instrument is constructed with symbols and by the aid of theories. Models require good 'model fit' (Oreskes and Belitz 2001, 24), and the construction of models may require inter-disciplinary research teams. Although critical views consider models as "fictions of some kind", such as Weisberg who has challenged their role as part of scientific knowledge; Sismondo (1999, 247) for instance has positioned mathematical models between pure science and needs of pragmatic action; from public policy to corporate strategy certain criteria such as objectivity is expected of them. Oreskes and Belitz (2001, 23-24) explain that scientific knowledge is by definition provisional and subject to uncertainty, because science advances, making a point about science as an institution, and perhaps implicitly referring to Herbert Simon's ideas about bounded rationalities, explaining that in seemingly rational decision-making, only a limited amount of information available (e.g. Simon 2000, 1991, 1955; see also: Gigerenzer and Selten 2002). Interestingly, there is some dispute whether models as a framework help explaining relations between interconnected facts and processes, or if models themselves are an answer to research questions by providing an explanatory framework (Frigg and Hartmann 2012).

Hardi and DeSouza-Huletey (2000, 60–61) suggest that measurement only makes sense when associated with models. The task of statistics is, after all, to learn from data (Davison 2003, 1) and researchers in social sciences, policy studies and business rely on statistical and econometric analysis. Numbers as logical constructions, absolute both in natural and social science, are generated and enable the experience of counting (Hacking 1999, 46). According to the measurement theory, empirical model is the real-world context in which measurement takes place, defining the issues to be measured, whereas the numerical model transforms the empirical model into measurable entities for data analysis (Hardi and DeSouza-Huletey 2000, 60-61).

Indicators and indices (Latin: *in*: toward; *dicare*: make known) are measurement tools for statistical purposes. An index has a mathematical function as number, which gives "the magnitude of a physical property or another measured phenomenon in terms of a standard", and a communicative function as "an indicator, sign, or a measure of something (McKean 2005). Indicators and indices refer to communication and mathematics, because numerical information both counts and expresses facts (Latin: *computare*; French: *compter* to count; *conter*, tell a story) (Erkkilä and Piironen 2009, 127). Semantically, the two terms (an indicator; an index) are used almost interchangeably because indices are indicators. Davis et al. (2011, 5) define an indicator as a named collection of rank-ordered data, generated through a process that simplifies raw data about a complex social phenomenon that purports to represent the past or projected performance of different units.

Indices can be constructed by combining data from different indicators that measure different dimensions. Belousova (2000) writes that indices can be simple, complex, multidisciplinary and inter-multidisciplinary by their structure, providing results in categories. Indicators use quantitative data, typically expressed in numerical format to point out the direction of change across different units and through time, when regularly evaluated (OECD 2008). This enables the manufacturing of rankings to compare different units such as countries to one another. Indicators should represent accurately and realistically the phenomenon they attempt or claim to measure, and in order to improve validity and reliability, they can be altered, refined and readjusted. It is worth noting that when experts from different scientific fields or non-experts use indices, carefully chosen language and terminology may help to avoid confusion about the purpose of an indicator.

In model-making and beyond, Hacking (1999, 74) considers that there are multiple ways to think, work and adapt to the material world. When most classical and neoclassical theories were created, the positivist philosophical approach was alive and well. However, post-positivism and the related theories have brought much anew to contemplate against entrenched truths. W.V. Quine, an American philosopher and logician, noted that even with all the possible data in the world, there would still "in principle" be infinitely many theories formally consistent with such data (Hacking 1999, 73), which only emphasises the challenging task to ‘manufacture’ not only a valid but also a representative model. A critical understanding of scientific knowledge within a narrative of the progress of science needs not to refute the value of scientific information, but helps to contextualise and critically assess the relation of theory to empirical facts. After all, the resolution of major scientific debates from the sixteenth century to the present has always involved sophisticated deliberation among experts (Kitcher 2010). In present time, global climate models have been criticised for inadequacy and inaccuracy despite massive data input and computing power; and economics, an entire scientific discipline, has been blamed for its alleged disguise in overly simplified theories that are detached from real-life observations (see: e.g. Dupré 1993).

Hacking (1990, 1984) has examined how the invention of probability brought chance, seemingly irregular events, under the control of natural or social law. In the words of Charles Babbage, society started to think numerically. Quantitative facts provide the administration with policy intelligence and evaluative capacity, and the aim of statisticians is to design, produce, analyse and present statistics in an ‘objective’ manner to the consumers of statistics who assumedly want to know the facts. It has been noted for a long time already that when complexity and interdependence in societies increase, statistics become increasingly relevant as the basis of policy-making and action

(Hauser 1973, 71). While Hacking (ibid., 7) as well as many other philosophers and sociologists, however, have chosen to speak less directly about the role of institutions and real-life politics; political scientists such as Erkkilä and Piironen (2009) have suggested that through the use of statistics and index data, social issues are conceptualised, framed, brought into discussion, and consequently made governable.

2.2 Indicators as a technology of global governance

Thanks to developments in computing, increased accessibility and quality of economic and social statistics as well as the improvements in and dissemination of statistical techniques (Davis et al. 2011; Bandura 2008, 2005), the use of indicators has been claimed to have become a "technology of global governance" (Davis et al. 2011). Indeed, for the latter part of the 20th century, nation-states have been calculating their national accounts, international institutions such as World Bank have begun to set "controversial" poverty lines (Ravallion 2008; Reddy and Pogge 2005), cities have started to measure their liveability, and individuals as well as professional organisations have been subjected to key performance indicators (KPIs) that assess the success of their projects with numerical targets. In the United Kingdom, the Government's development agency (DFID) now evaluates the performance of development agencies through a Multilateral Aid Review. Espeland and Stevens (2008) even speak about "a sociology of quantification". It seems that there must be a good reason for this, which makes one wonder whether anything could be quantified and governed – even sustainable development?

Governance (Greek: *Kubernân,* Latin: *gubernare*), historically, refers to piloting, rule-making or steering. Reaching increasing prominence in the 1980s, governance, the act of governing without government, is a notion of multiple meanings (Kjaer 2004; Weiss 2000). In 1991, World Bank defined it narrowly as "the manner in which power is exercised in the management of a country's economic and social resources for development (World Bank 1991). Rhodes (1997) provides a broader view in which governance refers to self-organising, intergovernmental or inter-organisational networks, resource-exchange, rules of the game as well as autonomy from the state. Hyden (1999, 185) notes the measures that involve setting the rules for the exercise of power and settling conflicts over such rules. A more policy-oriented view by Pierre and Peters (2000, 1) is more relevant, though, as they consider governance as the capacity of government to make and implement policy, to "steer the society". Global governance, steering the global society has been extensively studied in the IR and global politics literature (see e.g. Kjaer 2004, Wilkinson 2005), emerging as a counter-reaction to realist and liberal institutionalist theories (Weiss 2000). For

Rosenau (1995), the aspect of problem-solving global challenges is essential and refers to the systems of rule at all levels of human activity, in which the pursuit of goals through the exercise of control has transnational repercussions. And it is Weiss (2000) who identifies governance tangled with an increasing measurement of national performance (e.g. Soguel and Jaccard 2008), used for problem-solving.

If indicators govern, how do they govern? A plausible interpretation has been suggested by Bruno Latour, a French philosopher and an anthropologist, known as the author of actant-network theory (ANT). For Latour, the becoming of science is essential (1987, 216) and he aligns with Black (1962) and Dagognet (1984) to view statistics as "spokespersons" (Latour 1987, 237). Accounting, in particular, enables "action at a distance" (ibid., 219-232) and illustrates the power of numbers. Latour (1987, 1986) writes about the centres of calculus such as the International Bureau of Time or London Stock Exchange that are centres of measurement that hold together elementary parameters from the simplest of equations. Metrology (ibid., 251), then, refers to the long metrological chains that uphold such power structures, which demand a gigantic enterprise to bring the outside world inside and its facts inside a machine, within which they can survive.

Governmentality, the art of government, or the organised practices through which subjects are governed through dominant discourses, emerging from Foucault's writings (Foucault 1978; see also: Burchell et al. 1991)[4], is another common theme in many power analyses. For Foucault, the theory of the art of government is intrinsically connected with the knowledge of the state in all its forms, calling statistics a technology of power, or the 'science of the state' (Foucault 1982, 1978). For Foucault (1966), the order of things, or the way things confront one another in a hidden network, matters. Mathematics, for instance, is a structured language, an arrangement of signs conveying information in a structured form. Governmentality has widely been employed in analyses of power and international institutions (e.g. Alasuutari 2005; Lemke 2002; Oels 2005, Merlingen 2003, 2006; Rose and Miller 2008, Tietäväinen 2008). Bäckstrand and Lövbrand (2007, 126) label centralised multilateral attempts to manage the climate problem "green governmentality", in which the modern administrative state, mega-science, and the business community come together to almost reach the administration of life itself.

[4] Foucault's ideas on governmentality are visible both in Ian Hacking's thinking and the writings on the technologies of power (e.g. Burchell et al. 1991).

The third viewpoint to governance relates to modernisation. Quantification into numbers synthesises, summarises and visualises information that would otherwise be unattainable, making it useful in a multitude of purposes and technologies. In Western societies, statistics and probabilities have caused "an avalanche of printed numbers" (Hacking 1990, 2). Latour (1986, 20-21) elaborates nine advantages of objects turned into figures. Inscriptions as paperwork are mobile, immutable and flat, and can thus convey information. They can also be recombined and reproduced, not to mention being manufactured and spread at a low cost. Their scale can be modified without changing the actual phenomenon; they can be made part of a written text or merged with geometry to enable information as words and different shaped objects to be carried. Origins of different scales can be superimposed on the inscriptions, allowing different types of things to meet (ibid.). Although Latour's writings date to the 1980s, numbers as information objects maintain their functional, communicative and implicit but powerful character. Similar principles apply to many objects such as maps (see also: Turunen 2013) and in the digital era of the 21st century, many such qualities remain unchanged, even if they have assumed a new digital form and networks to operate in.

Unsurprisingly, both Foucault and Latour also see these principles apply all too well to the nature of political economy. Foucault (1966) exemplifies how two completely separate disciplines, economics and geology, are able to meet when natural resources are traded in the stock market. Similarly, for public policy, the introduction of economy into political practice meant that economy began to govern a state and its inhabitants, and when it is applied at the level of the entire state, it becomes an interactive means of both surveillance and control (Foucault 1978, 92). Latour understands the "power of economy" in a fairly similar fashion albeit from a different point of view: for Latour, this power manifests as a cultural trait embedded in societies – in the habituation of people into networks of calculations. As a cognitive tool, money makes a perfect example of a mobile, immutable, countable and combinable function used to code all states of affairs (Latour 1986). Economy is in the assembly of economy from every sold hamburger or bus ticket, transformed into numbers in cash registries, delivered to accountants, managers and economists (Latour 1987, 254). In a Foucauldian sense, information is tacitly reproduced in the interaction and exchanges of networks with the centre. Furthermore, the introduction of communication technologies may have only accentuated and reinforced the power of economy. Until the mid-20th century, economy remained a rare object on the front pages of newspapers; whereas these days, reports of economic downturns cause fear in the whole society (Hacking 1999) and in the political level, these same budgetary bottom-lines determine policy-making. Of course, such observations do not imply that economic shifts would not have real implications. Rather, Foucault, Latour and

Hacking want to remind us how intrinsically human life today is linked with economy also in practices, even if people rarely come to think of these connections and various mechanisms that govern a whole society.

Understanding this makes it easy to see why the development trend to use increasing amounts of information for the purposes of governance is a value-laden idea. But what is more, although this governance may seem no more than a technique, over the recent years, it has come to embed, if not captured (Stoker 1998), by its connotations to "good governance" and the ideology of "new public management" (NPM). As a technical management rationale, NPM demands reform aspects of political institutions and often measures them in targets and expresses them in numbers. Efficiency gains tackle the unresponsiveness and unaccountability of the public sectors towards citizens, following the principles of the Chicago School in economics and the work of Ronald Coase and Oliver Williamson (Kettl 2006) that wanted to distinguish policy-making from its administration. The NPM emerged from New Zealand and UK in the late-1970s and became mainstreamed with the privatisation trend in Western countries in the 1980s under Thatcher, Reagan and Kohl administrations (Weiss 2000, 798-799; Chomsky 1999). Gradually, the NPM trend has changed the ideas about governance, considering political and institutional reform as prerequisites for better national (and consequently global) economic performance (Kjaer 2004; Weiss 2000).

However, the critics point out that as a reform orientation, the NPM does not only demand accountability and efficiency, but has also subjected the public sector to serve the logic of market principles. Good governance, an associate of the NPM language, has become a value-laden term because it epitomises the so-called Washington Consensus of the Bretton Woods institutions, IMF and the World Bank in the 1980-2000s, manifested in the structural adjustment programmes (SAPs). In development policy circles, the common wisdom conceives that in the 1990s, the baby was thrown out with the bath water, and that development "lost a decade" because the developing countries that were subjected to the SAPs experienced highly mixed results. In targeting efficiency, drastic cuts in the public sector and controversial privatisations were made, following an ideology in which only setting the prices right, matters. In an international system of imbalances of capital, knowledge and power, the idea of thriving markets or an economic take-off in developing countries never realised, and the "neoliberal paradigm" (Mirowski 2009; Teivainen and Patomäki 2003; Chomsky 1999, 122-123) became a curse word, attracting stark criticism from development scholars across the field. In spite of its likely merits, these days there are many who disagree with the ideas of NPM, in which government is expected to "function like a firm" not only by

performance indicators, but also to deregulate and privatise (Klijn et al. 1999, 3). An understanding of this ideological undercurrent is important in order to separate the technocratic ideals of measurement from the political and ideological aspects towards free-market principles. In the worst case, the hegemony of numbers could create an illusion of an apolitical and value-free economic sphere beyond political control or regulatory power, as might have been the case under the ideology of neoliberalism (Mirowski 2009). Perhaps, what some fear is that an increasingly economised mode of rationalisation could actually narrow the scope of ethical reasoning. Kjaer (2004, 10) actually sees it as the duty of academics to defend the notion of governance from being hijacked by the proponents of such policies.

Regardless, in the 2000s in the field of global governance, indicators have found a comfortable space to operate in (Bandura 2008, 2005). In recent years, the charm of numbers has penetrated various development-related debates, with the most renowned indicators including the likes of the *Corruption Perceptions Index (CPI)* launched by Transparency International in 1995; *The Failed States Index (FSI)* published by the US-based think tank Fund for Peace and the Foreign Policy magazine from the year 2005; *The Global Peace Index (GPI)* by the Institute for Economics and Peace; and *The Press Freedom Index* of Reporters Without Borders since 2002. Indicators seem to matter because the measurement of national-level performance enables the scaling-up of any debate also in the international context.

So what about indicators of sustainable development, where do they find themselves? A need to develop them was outlined already in the Rio Earth Summit 1992 and the Agenda 21, a voluntary action plan on sustainable development. In 1996, an international group of leading measurement practitioners developed the Bellagio Principles (see: Annex II) to provide guidance for the measurement of sustainable development. Over the years, a vast amount of indicators have been developed but with modest political visibility. However, the evidence that has accumulated over the years suggests that SDIs could provide added value to decision-making when they are employed instead of the GDP. For instance, the common narrative about the Reagan-Thatcher era suggests that strong economic growth and efficiency gains pushed the humankind forward; but certain SDIs such as the Index of Sustainable Economic Welfare (ISEW) interestingly show decreasing levels of achievement in the UK, the U.S. and other Western countries (Max-Neef 1995). A review meeting only followed in 2009, co-organised by the OECD's Measuring the Progress of Societies initiative and the IISD (Pintér et al. 2012). However, in the Rio+20 conference in 2012, the call to move forward in the assessment of the progress of societies gained new traction. And in a few years, the

states will again gather to set a new development agenda to the international community in the UN General Assembly, after having adhered to the promises made in the Millennium Declaration in 2000 that could further provide a ground to continue this debate.

The motivation to make such remarks is provoked by Porter (1992) who suggests that the conventions of measurement may be arbitrary or explained as results of the time when the measures were created. While international comparability (Erkkilä and Piironen 2009, 131; Morse 2004) may be interesting as such, it seems that more is demanded than simple mathematic calculations for indicators to rise in a position where they are recognised, valued and employed for policy purposes. Such observations may matter because Porter (1992, 635-636) suggests that "rules and entities" give strength and stability to accounting. And of course, for Latour (1987, 1986), the essence of power is explicitly always in the networks built around objects. These registries transform local knowledge into universal, turning implicit facts explicit and beliefs into knowledge. And what is more, these networks are enabled, maintained and supported by stable and standardised institutions.

2.3 Institutions and the framing effect

If we look at institutions and their role in a debate concerning measurement, the first remark concerns their analytical capacity to make sense of the surrounding world. In a practical sense, they act as filters (Hay 2006) that frame problems, provide advocacy and in terms of political choices alter the space of manoeuvring. Politicians and policy makers, then, use expert advice and evidence that institutions provide in order to ground their decisions and to justify policies. Institutions are considered to regulate behaviour and ensure that certain things are taken as given, for their rules and practices determine what is considered reasonable or normal (March and Olsen 2006). And what is more, particular institutions of the international system may be argued to not only have knowledge resources, but considerable political, economic and financial influence that shape what is possible. The idealist tradition of British political science (Oakeshott 1991) in particular suggests the need to contextualise institutions and understand their actions accordingly (Hay 2006).

Discursive institutionalism (DI) investigates why certain ideas constitute political action while others do not. In particular, DI attempts to study change by considering agents not only able to maintain institutions but to constantly re-create them through their own actions (Schmidt 2008). Actions manifest ideas, which are switches for interests, road maps and narratives that shape our understanding of events (Schmidt 2008, 306). Schmidt (ibid.) elaborates cognitive ideas that clarify "what is and what to do" as recipes for policies and programs from normative ideas which indicate

"what ought to be done" – how policies solve problems. Ideas, thus, are found (at least) in three institutional levels: philosophies, policies and programs. In addition, ideas become linked with the context through discourse. As explained by Foucault (1982, 1969, 1966), knowledge as a discourse constitutes the practices, statements, modes of articulation, and the space what can be said in a certain context. Foucault was interested in the history of ideas, and so are discursive institutionalists who have emphasised how ideas play a part in both *maintaining* and *creating* the institutions they involve themselves with (Schmidt 2008).

Foucault (1966, 202) was interested in the ways knowledge is embedded in institutional regulations and political decisions. Constructive institutionalists, in turn, have elaborated the need to identify and interrogate how ideas have become embedded in institutions in the first place (Hay 2006). Understanding these ideological currents may matter because under uncertainty, political decision-makers and technocrats within institutions are willing to turn to these institutions and epistemic communities for advice. According to Haas (1992), experts have a significant role in the articulation of the cause-and-effect relationships of complex problems. In transnational settings, loosely connected individuals may be able to form and shared cognitive and normative ideas about a common policy enterprise and expect the diffusion of new ideas and information to lead in new patterns of behaviour (ibid., 2-3).

Discourses in the international level need to be scrutinised due to possible global implications of such discourses. After all, political scientists have known (at least) from the mid-1950s the international institutions to have capacity to influence domestic politics (Martin and Simmons 1998). The emergence of the post-WWII international regime – the birth of Bretton Woods institutions and the United Nations in particular – created strong expectations towards intergovernmental entities. International institutions enable states as well as other stakeholders to meet, and thus they may construct narratives, articulate interests and facilitate the horizontal exchange of ideas and policies at an intergovernmental level, whereas states mainly articulate policies in the national scope. Such platforms can be argued to be important because the growing technical nature of global problems demands increasing amounts of expert knowledge. Expertise, however, may be argued to encompass almost any type of knowledge resources, while in reality, different ideologies frame the use of expertise.

These views emphasise the role of control over knowledge as an important dimension of power. Through the lenses of DI, this also provides certain type of hope because under global challenges,

DI emphasises the belief in the ideational abilities of individuals. Within and near institutions, technocrats and other experts are seen to have the ability to choose their beliefs, not only maintain, but also create change into institutional discourses. Ideally, of course, these beliefs would be based on as comprehensive deliberation as possible to avoid narrowly framed exchanges of opinion, and after such debates, the best arguments would prevail and guide policy-making. Discursive institutionalism supports the ideals of deliberative democracy (Dryzek 2000), which in itself enables democratic access to decision-making (Schmidt 2008), but also reinforces the view of institutions as flexible and able to adapt to changing contexts.

However, some researchers argue that the power of ideas might not be as mighty after all, and others are sceptical of the influence of international institutions. Realists and neorealists have advocated researchers to focus on domestic politics and the nuanced mechanisms of influence in the micro-level as well as feared that top-down views delude researchers into over-simplification and a treatment of states as single units (see e.g. Alasuutari 2005; Martin and Simmons 1998). These are genuine threats. In my view, this study attempts to counter both threats. First of all, inarguably *some* ideas uphold the logic how different types institutions from states to non-governmental organisations operate. Secondly, politics at the grassroots or national-level decision-making may surely have more "real" day-to-day implications for peoples' lives. In defence of discursive institutionalism, whereas other institutionalist approaches have struggled to explain change; the idea that people themselves bring about change as the carriers of ideas seems intuitive. Also, this allows change to happen both from the bottom to the top as well as from the top to the bottom. Actually, DI gives knowledge a form, in which it is able to make an impact, if only it finds the right people, at the right context – at a right time (see also: Schmidt 2008).

Nonetheless, I argue that while a DI approach may bring a level of optimism in a field of critical researchers, in explaining change resistance, the earlier political science traditions are well fit for purpose. The early institutionalist approaches focused on the state, formal government institutions, constitutional issues and public law (March and Olsen 2006, 5), and all of these inevitably form the playing field where any new ideas must assume their position. Also, the three paradigms of "new institutionalism" (Hall and Taylor 1996)[5]: sociological institutionalism (SI) that views institutions as the reflections of norms and culture; historical institutionalism (HI) that studies how history has shaped institutional preferences and recognises preferences as rationales embedded in institutional

[5] Where Hall and Taylor listed three new paradigms, Peters (1998) actually distinguishes seven distinct approaches to institutional studies

rule structures, shaped by ideas and interests as human-constructed artefacts (Sanders 2006, 39-42); and rational choice institutionalism (RCI) that takes institutional preferences for granted (Pierson 2004) to evaluate decisions from the calculus approach and game-theory view – all offer insights that could well explain why certain institutions act the way they do[6].

Institutional analysis studies how institutions affect political behaviour and how institutions emerge, change (Kjaer 2004, 9) and resist change. And even if the common criticism against most institutionalist paradigms has been their inability to explain what stops institutional continuity, this study can provide food for thought into how different institutionalist approaches can complement each other[7]. The temptation to primarily employ discursive institutionalism is in its suggestion that only new ideas and discourse have an ability to cause demands of institutional response (Schmidt 2008). Where RI may provide "an account of interest-based ideas", DI can explain and deeper examine them (ibid., 319-320). In turn, the paradigms of new institutionalism can help explain why institutions contain a significant amount of stagnancy bounded by the norms, rules, culture and their internal organisations, and rationalist paradigms can help us understand why institutions should be considered as strategic actors, despite the potential power of ideas to bring about change. And, there are even those not at all agree with the accusations or the rigidity of institutions. Weaver and Rockman (1993; cited in March and Olsen 2006) neither see institutions as static, nor their behaviour inevitable or irreversible; and although RI makes a fashionable target for criticism, two rationalist institutionalists (Martin and Simmons 1998, 750–751) suggest that change in secondary rules, rules over rules, may open up space for unexpected consequences, leverage over policy and institutional change[8]. Furthermore, Shepsle (2006, 35) considers that the 'once so powerful' rational

[6] RCI adheres to the traditions, epistemological and ontological choices of economics, SI those of sociology and HI those of political science. SI sees norms to reflect the exogenous history and norms of the polity or the organization; whereas RCI takes an endogenous perspective to institutions. HI, also an heir of the rational choice paradigm simply differs from RCI in its objects and time span. While the approaches of new institutionalism have succeeded in the examination of the structural context of institutions and countered the influence of the rational choice paradigm, which merely portrayed institutions as strategic actors, they also have their weaknesses. Historical enquiries may enable learning from past experiences and increase contemporary understanding to reveal hidden motives, but also reinforce existing conflicts and worldviews. Sanders (2006, 53) accuses the HI approach for determinism and an emphasis of the limitations of institutions. In the international context, HI seems to applaud the expansion of the nation-state and lead to an inevitable modernization focus. SI, on the other hand, may also be considered too stagnant for its emphasis on structure over agency – too much for the liking of some.

[7] According to the critics, the inability to explain has made institutionalist paradigms portray institutions as stagnant and their paths deterministic. At best, change has been explained by external shocks, which have caused "critical junctures" in the continuity of an institution. This resistance for change, perhaps, tells something about the scientific paradigms of the 20th century. The lack of capacity to explain change is in the standard model of punctuated equilibrium, which simply assumes discontinuous change and results in the assumption of path dependency (March and Olsen 2006, 12).

[8] Similarly, while at the early stages also international institutionalists were mainly interested in the study of rules and norms, later the research of international institutions has evolved to cover various questions from processes, structure and outputs of influence to alliances between international bureaucracies and domestic pressure groups as well as international regimes and international cooperation, and so forth (Martin and Simmons 1998, 732–740).

choice paradigm, often criticised for its assumptions, increasingly responsive and suggests that the distinctions between RCI and its institutionalist cousins have weakened.

Ideas matter but one important means how they matter is through the choice of framing (Kahneman 2011) to choose a particular means of representation (Hacking 1983). That is how ideas intervene with and operate in the world we live in. This is also expressed in the case of institutions. Radically different viewpoints can express and examine physical phenomenon in multiple ways. Today, international institutions such as IMF, OECD, UN and the World Bank publish increasing amounts of data, partially in order to respond to earlier criticism and the accusations of a lack of accountability and transparency. But it is even possible to suggest that the communication strategy of IFIs to actively provide information makes the search of alternative political choices even more difficult because numbers increasingly penetrate the language of high-level political discussion and contextualise problems on behalf of the public. As the quantification of problems into numbers is associated with a need of expert knowledge (Kahneman 2011, 217), seemingly technocratic indicators can hide ideological assumptions (see also: Erkkilä and Piironen 2009). And while an increased provision of information to the stakeholders from intergovernmental organisations to the general public is indeed a prerequisite of accountability, this increased transparency does not necessarily change their policies (Scholte 2011).

Hay (2006, 70) suggests that in times of crisis where conflicts of interests emerge, explaining ideas is more important than in peaceful times, when non-constructivist techniques are satisfactory. As this study examines global challenges and the way they should be understood and reacted to, discursive and constructivist approaches that both attempt to elucidate rationales and enable an understanding of power through contextualisation seem appropriate choices. In order to understand these institutional perspectives more concretely, it is now timely to turn to the idea of sustainable development, a notion of multiple meanings. I will argue (H_1) that 'sustainable development' has both sought to challenge the modus operandi of international politics, and in doing so, also created institutional mechanisms and expectations of its own, confusing and binding researchers who in spite of ecological concerns have struggled to substantiate their message about ecological limits, and perhaps even become distracted from the root cause of ecological concerns, that is, the levels of energy and resource consumption.

3. Sustainable development and its indicators (SDIs)

3.1 Environment and development, sustainable development and the green economy

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

(WCED 1987, 41)

Sustainable development (hereby: SD) has become a popular catchword since its mainstreaming by the World Commission on Environment and Development (WCED) or the Brundtland Commission report *Our Common Future* (1987) and the international Rio Earth Summit that was organised in 1992. The WCED definition (see: above) of SD emphasises the needs approach and intertemporalilty, meaning equity between generations. As an idea, sustainable development has attempted to build a process of change (WCED 1987, 17) that concerns both industrialised and developing countries, after emerging as a response against development that both leaves "increasing numbers of people poor and vulnerable, while at the same time degrading the environment" (WCED 1987, 12). Over the years, the discourse about sustainability has become common parlance, rapidly finding establishing itself in the vocabulary of decision-makers and the broader public. In addition, for the purposes of management, SD has usually been practically defined by an elaboration of a triple-bottom line with economic, social and environmental dimensions as well as a suggestion that the three should be taken into equal consideration in decision-making.

The environmental argument for sustainability stems from the *threshold hypothesis* that questions indefinite economic growth. Economic growth, which is necessary from the standpoint of economic theory (Aghion and Howitt 2008), should prove impossible in a world of finite resources, as explained already by *The Ecologist*'s special issue, *A Blueprint for Survival* in 1972 – the same year that saw the publication of The Limits to Growth (Meadows et al. 1972) by the Club of Rome and the organising of the first major international conference on environment and development – the UN Conference on the Human Environment in Stockholm. In hindsight, these projections mentioned above have proved quite accurate. With regard to The Blueprint's predictions, trends about global warming, deforestation, soil erosion and pollution have fallen in place; and only predictions about the depletion of mineral resources have proved overly sceptical (Lawn 2003, 105–106). Turner (2008), in turn, who studied the scenarios of the Limits to Growth (1972), found that based on an assessment of data from 1970 to 2000, the global system is on an unsustainable

trajectory, following the report's "standard run scenario", which suggested a collapse by the mid-21st century. Both reports conclude that only changes in consumption patterns combined with rapid and significant technological progress would mitigate risks. In turn, the social argument for sustainability is defined in particular through the intergenerational perspective, where the future generations should have equal opportunities to the generations in power now. More broadly than that, SD can be alleged to assume a global perspective and be interested of rights and the needs of the poorest and consider issues such as the equality of opportunities, the income gap between the rich and the poor and power relations in the system of international politics. However, the definition may be assumed to be under a constant re-negotiation and re-definition inside the vacuum of international diplomacy.

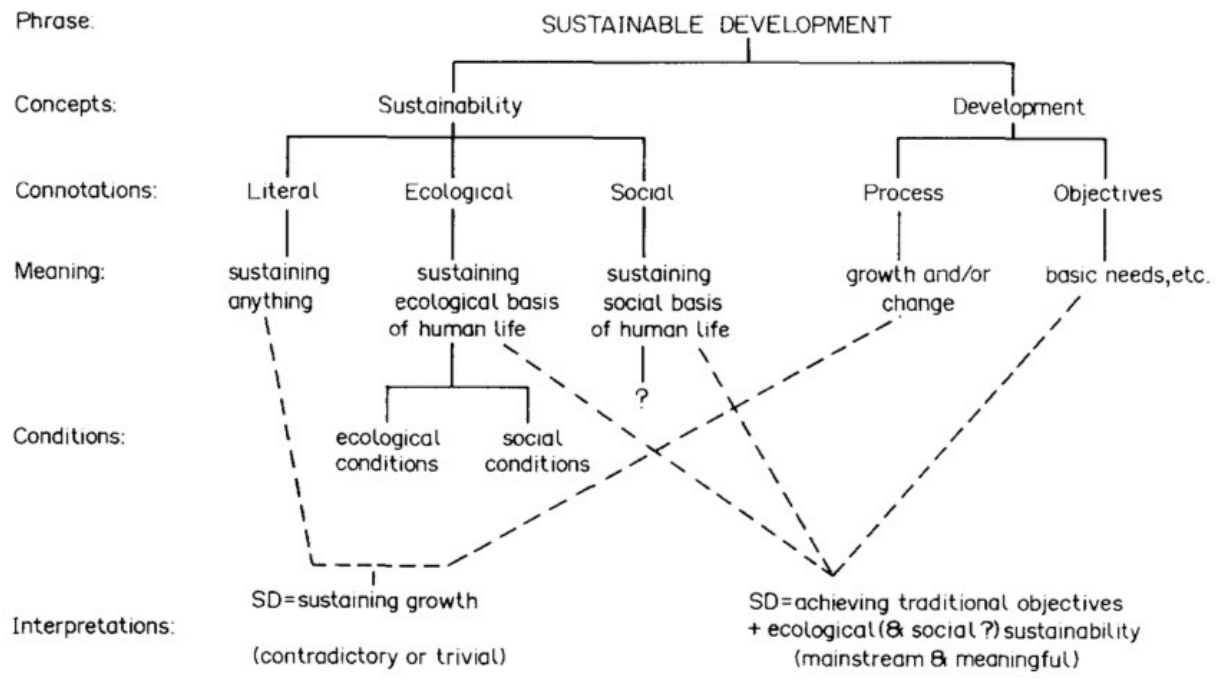

Image 1: Semantic analysis of sustainable development (Lélé 1991)

In spite of the attractiveness of the vision of sustainable development, it is worth remembering that the concept of SD has also had its critics from the start, not least for the arguments of SD being considered a notion that is difficult to operationalise and implement (Marshall and Toffel 2005, 673). This semantic map *(Image 1)* illustrates some of these fundamental tensions. Lélé (1991) in particular highlights how SD problematically combines both *ends* and *means*, which at times may go unnoticed, but for the coming analysis, the distinction between a transformational process and an objective as a state of being, is important. Perhaps the most controversial issue regards the dualism

between the environmental and developmental dimensions. In Lélé's breakdown, *sustainability* is associated with the conservation of ecological and social conditions; and *development* is associated with the objectives of attaining basic needs (and beyond) through a process of change that at least implicitly demands economic growth.

There is, undoubtedly *attraction value* in the SD notion, both as a process and an ideal and even sceptics would acknowledge that there have been efforts to achieve sustainable development as an *ends*. Economic growth as a driver of human development has needed a social movement to argue for a redistribution of economic gains to achieve a welfare state; an environmental movement to balance economic externalities such as pollution; and now climate change is challenging the entire material basis of growth. As a process, SD seeks to bring forward both conceptual and behavioural change. In the academia, new approaches and sub-fields have emerged from economics to sociology and political science (Ostrom 1990), including the likes of ecological economics (Daly and Cobb 1989) or the science and management of sustainability (Costanza 1991). In decision-making, SD has attempted to standardise heuristics to move from economy-oriented consideration *only* to conceptualise policy-making as a holistic task that demands consideration on environmental, social and economic aspects simultaneously.

At the onset, when the SD was incepted by the IUCN in its World Conservation Strategy in 1980, Redclift (1987) considered SD merely yet "another development truism", which was not considered to adequately challenge controversial or sensitive issues such as the international economic and political order or address consumption patterns that are integral to economic growth (Khosla 1987; Sunkel 1987; cited in Lélé 1991). Using the notion of SD, people with irreconcilable positions have been able to search for common ground on environmental, social and economic issues (Lele 1991, 607–610), which in international diplomacy in particular has been helpful (Schmidt 2008, 311). Intentional or not, international negotiations have had a central symbolic role as the platform for the sustainable development debate (Lélé 1991), but the discussion about sustainable development has also become somewhat locked in North-South polarisation of the international politics (Williams 2005; see also: Ivanova 2007), following the principle of common but differentiated responsibilities (CBRD), meaning that developing countries cannot bear similar responsibilities of the consequences of industrialisation as developed countries due to their lesser resources[9]. The priority of developing countries has understandably been socio-economic concerns: industrialisation and

[9] Prior to the notion of sustainable development, environmental conservation and development were considered two opposing issues; a dichotomy and a tension which still often manifests in different occasions

economic growth linked with poverty alleviation, health and education; whereas the Northern countries were the first to push for the tackling of transboundary environmental challenges in the 1960s, after having recognised the effects of pollution and environmental degradation. Developing countries have been were wary of environmental concerns as Western protectionism "in a disguise", wanting to ensure that actions of global environmental governance do not hinder their "right to develop"' as outlined by Indira Gandhi in his famous speech in Stockholm in 1972[10]. For developing countries to achieve "environmental leapfrogging" (Watson and Sauter 2011; Munasighe 1999), or bypass the polluting stages of development, they would need technology transfer from the industrialised countries.

The landmark conference of Rio Earth Summit 1992 enabled the surge of an international movement for sustainable development through Agenda 21 with its many goals and targets, including the call for to measure sustainability as well as set the CBDR as a fundamental principle in international law. The decennial follow-up conferences Johannesburg in 2002 (WSSD) and Rio+20 conference in 2012, gathered less momentum and changed little in the *status quo*, although they engaged more prominently towards the involvement of the private sector to jointly tackle sustainability challenged. Now, the climate challenge is yet another major concern of many developing countries vulnerable to its consequences while historically not responsible for the accumulation of greenhouse gases. While the developing countries have been reluctant to shift official development aid from socio-economic development to other priority areas, the advanced economies, in turn, have struggled to provide "additional" financing to combat environmental challenges while holding onto their own international privileges in the areas of subsidies of agriculture and trade and IPR rights. Inevitably, these entrenched dynamics have influenced other political fora as well, including the yearly climate talks, which have managed to achieve limited progress since they were initiated in Rio (1992).

Recently, a notion of green economy (hereby: GE) has emerged. A working definition by UNEP, which depicts the GE as an economy "that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011, 1) has often been employed. Nevertheless, like sustainable development, the concept has remained open for interpretation. In Rio+20, countries were unable to agree on the specific content of the concept[11]. Some who have been critical of the GE reject the notion because the consider that the

[10] For the whole speech, see: Gandhi 1992
[11] See: Rio+20 Outcome Document: The future we want (UN 2012)

introduction of a new concept only creates unnecessary confusion into issues already familiar from SD and a new layer of problems. It has also been feared that an economically motivated marriage of the economy and the environment will lead in the commodification of nature, exploitable to the free markets while leaving social issues aside (Morrow 2012, 294-297). UNEP (2011) itself has suggested that GE would not replace SD, but rather aim for an economic transformation in which the "brown economy" would be replaced with a "green economy".

Twenty-five years after the Brundtland Report, the concerns and the arguments for sustainability remain much the same as when first presented: while some environmental pressures have been tackled, progress in others has been modest (UNEP 2012), with the climate issue in particular is now as a new, major global transboundary concern. Growth across regions has been uneven, and socially, the welfare gap between the developed and developing countries remains considerable in spite of significant aggregate economic growth globally; and recently also inequalities inside the industrialised countries have widened (Milanovic 2013; OECD 2011, 2008; UNCTAD 2012).

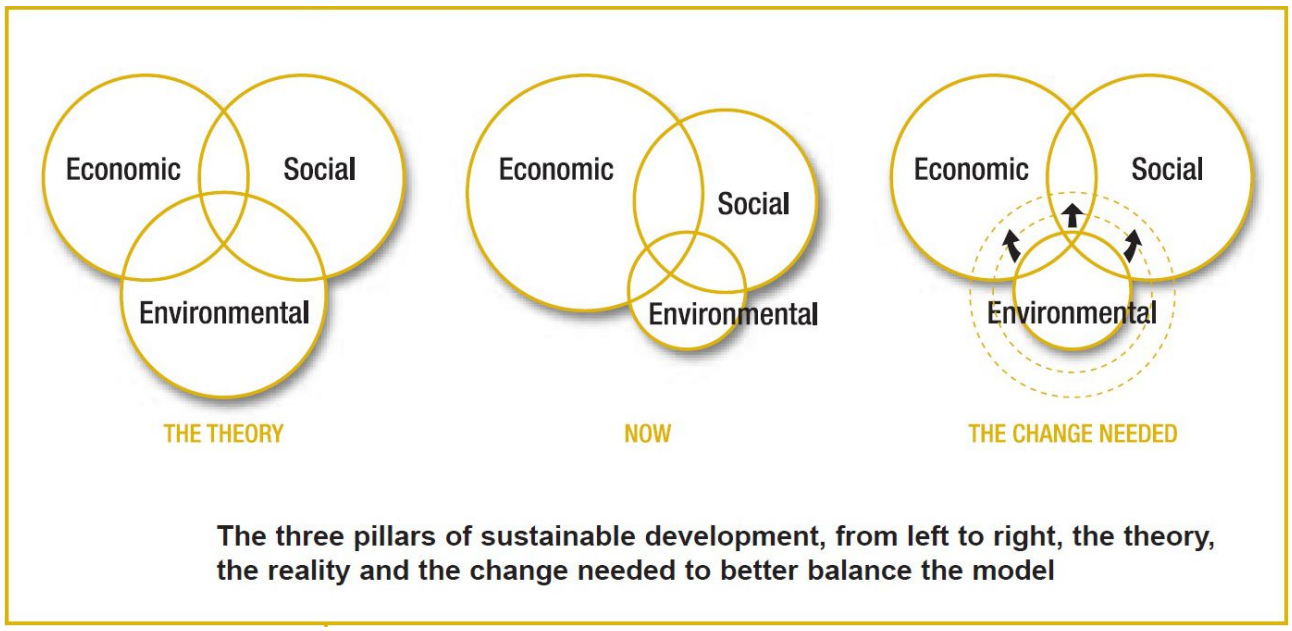

Image 2: The three dimensions of sustainable development and a suggestion of necessary change. (Source: IUCN 2004)

Littig and Grießler (2005) suggest that one reason to the lack of progress lies in the fact that the institutional dimension of SD has often been overlooked, even if institutions are the key actors in the implementation of policies. From a normative perspective, environmental research and advocacy bodies such as the IUCN have suggested (*Image 2*) that although in theory, the three SD dimensions are in balance; in political decision-making economic bottom-lines tend to dominate

social and environmental considerations. All in all, whether there has been "enough" of sustainable development may be difficult to determine and perhaps also for these reasons, legitimate indicators have been sought to provide standards and an answer on how societies are progressing towards the political ideal of sustainable development.

3.2 Indicators of sustainable development (SDIs)

In terms of measurement, is it possible to measure a state of society or a notion, which has been considered conceptually imprecise, confusing in terms, nebulous, ubiquitous, vague, and even elusive (Marshall and Toffel 2005; Buttel 2000; Lélé 1991)? Those constructing indicators of sustainable development (SDIs) believe in the value of producing bottom-lines in order to attract the attention of policy-makers (Prasad 2004), popularise complex issues, and to put in place actions that can be monitored in order to indicate whether we are moving onto a sustainable trajectory, bearing in mind both current and future generations (Moffatt 2008, 86).

Anielski and Soskolne (2002, 83) suggest that indicators are not only critical for the monitoring of the health of ecological systems, but also serve the functions of the wider society *and* the economy. In terms of accounting, SDIs can be classified on the basis, whether their approach attempts to *quantify* the state of a society or alternatively describe prevalent *trends*. When a SDI measures a state of being it measures *stocks*; and when repeated measurements over time are performed to observe change over time, one is looking at *flows*. This terminology is commonly used in accounting as well as system dynamics models such as the modelling of environmental, economic, and environmental-economic systems (see also: Forrester 2009; Borschev and Filippov 2004; Ford 1999).

It needs to be kept in mind that 'the indicators of sustainable development' actually constitute "an umbrella term" under which various attempts to construct a meaningful indicator may be gathered: indicators can be classified based on different approaches; they appear and operate in different contexts and they have different contents. Nonetheless, somehow common to them is their motivation to reflect upon the issue of ecological sustainability, and often against or with economic and social considerations. Since the late 1980s, scholars have worked to develop both alternatives and substitutes for the GDP. Already, various composite indices of sustainable development have emerged as a result. As indicators and accounting systems, many SDIs have attempted to move beyond an economic view and the deficiencies of GDP in order to incorporate the measurement of environmental sustainability and welfare or well-being (Hoffrén et al. 2011; Stiglitz-Sen-Fitoussi

2009) amongst other values. However, the ecological economists in particular, have attempted to work with the economic logic and expand the boundaries of economic thinking. Up until now, however, there have been no internationally agreed metrics on how to monitor progress (see also: UNCSD-S 2012).

Indicators of sustainable development may either view certain issues *one-dimensionally* (e.g. taking an environmental, social, or economic view); they may be *additive* by adding or subtracting values from a selected baseline (for instance punishing economic growth figures for environmental losses); or they might choose to aggregate different dimensions into a *composite index* (such as the three dimensions in the SD triple-bottom line) in order to calculate an overall score. As technical operations enable different outputs from a model construct, it is essential to bear in mind the different modes (dynamics, thresholds, time horizons) based on which the three different systems (environmental, social and economic system) operate. All of these approaches have their merits and disadvantages. An overview to the different techniques is provided here, and the significance of these approaches will be further clarified later in the paper through a review of different SDIs.

One-dimensional indicators analyse a single aspect, one chosen phenomenon. For instance, economic indicators measure *only* the state of the economy; environmental figures reflect upon changes in the health of ecology following natural science-based data; well-being indicators consider social aspects; et cetera. For instance, if one chooses to measure sustainability one-dimensionally, the level of greenhouse gases could be well argued to be the most relevant figure[12]. The adoption of a single bottom-line, nonetheless, is aware of the fact that the accumulation of carbon emissions does have impacts on other dimensions (environment, society and economy – locally and globally), too. Because researchers are wary of the trade-offs between different dimensions – after all poverty, economic growth or unemployment are urgent bottom-lines as well – they have been motivated to seek alternative measurement strategies.

Additive indicators choose a dominant dimension, and under its logic, other dimensions are accommodated. For instance, monetary systems of green accounting, or 'the green GDP' are additive indicators because what they do is – *add* and *subtract*. Also in the calculus of indicators such as the Genuine Progress Indicator (GPI), the Index of Sustainable Economic Welfare (ISEW)

[12] Greenhouse gases include CO_2 and other greenhouse gases: CH_4, N_2O, HFC, PFC, and SF_6, identified by the Kyoto Protocol. When all GHGs are measured, the unit is kg $CO_{2\text{-e}}$, that is, CO_2 equivalents. If only CO_2 is measured, the relevant unit is kg CO_2. Those are calculated by multiplying the actual mass of a gas with the global warming potential factor for this particular gas, making the global warming effects of different GHGs comparable and additive.

and the Sustainable Net Benefit Index (SNBI), the economic baseline (typically the GDP measuring the total amount of production) is adjusted to reflect the externalities of economic growth. This includes different types of environmental or social costs. As they are measured in the units of money, seemingly these indicators are close to the daily life. After all, it is difficult to escape the monetary economy in practical decision-making.

Composite indicators make the third SDI category. These indicators use the technique of composite indexing in order to compile information of multiple underlying variables. Their strength has been said to be in the measurement of multidimensional concepts, such as sustainable development, that could not be captured by a single indicator. In aggregating different dimensions into one measure, they have been argued to be valuable in the analysis of a problem (Canoy and Lerais 2007)[13]. To describe briefly how they are constructed, I will give an example of a typical effort to use composite indexing. The first step is to select the relevant dimensions. In order to strike a balance with the different dimensions many composite SDIs employ the triple-bottom line logic. After a selection of the relevant dimensions, which are likely (at least) three, suitable indicators are then defined. The state of the economy might be represented with economy-related sub-indicators like growth, debt or prices; social issues would be incorporated from statistics related to issues of gender, health or employment; and the environmental dimension would measure carbon emissions, biodiversity, and/or pollution, and so on, and so forth. Also other issues (e.g. political, gender, governance, human rights, cultural) that are considered significant could either be incorporated as a separate dimension or as sub-indicators that constitute a particular dimension. In order to balance the representation, the indicators could also be assigned relative weights in order to adjust their proportions in the model. For instance, if the three SD dimensions (economic, environmental and social performance) were considered of equal importance, each dimension would constitute one third of the overall score and there would be no need for weighing. In contrast, if the overall score would seem misleading in relation to what the indicator is supposed to represent or some of the dimensions would need to be emphasised more than others, the indicators constituting the index could be assigned weights. To read about the advantages and disadvantages of composite indicators, see to the end of the paper (Annex III)[14].

[13] Booysen (2002) distinguishes four technical steps to composite indexing: the selection of variables and components; scaling; weighting and aggregation; and finally validation, followed by refinement in order to improve reliability through trial and error.

[14] For detailed methodology, see e.g. Booysen 2002 and OECD and EC-JRC 2008. Also various research papers discuss in rich detail the technical qualities that a good indicator should possess.

Research projects have aimed to provide conceptualisations in order to pin down what the measurement of sustainable development consists of. To give an example, a recent project called Beyond GDP (2007-2011) of the European Commission elaborates five spheres (*Image 3*): *the GDP* and *other economic indicators* (measure the state of economic activity but neglect non-economic issues); *the enlarged GDP* (as additive indicators adjust the economic calculus to consider issues social or environmental losses as costs); *social indicators* (view social issues, trends and concerns); *environmental indicators* (deliver information of general or specific ecological issues); and finally *well-being indicators* (describing living conditions, life satisfaction, or quality of life).

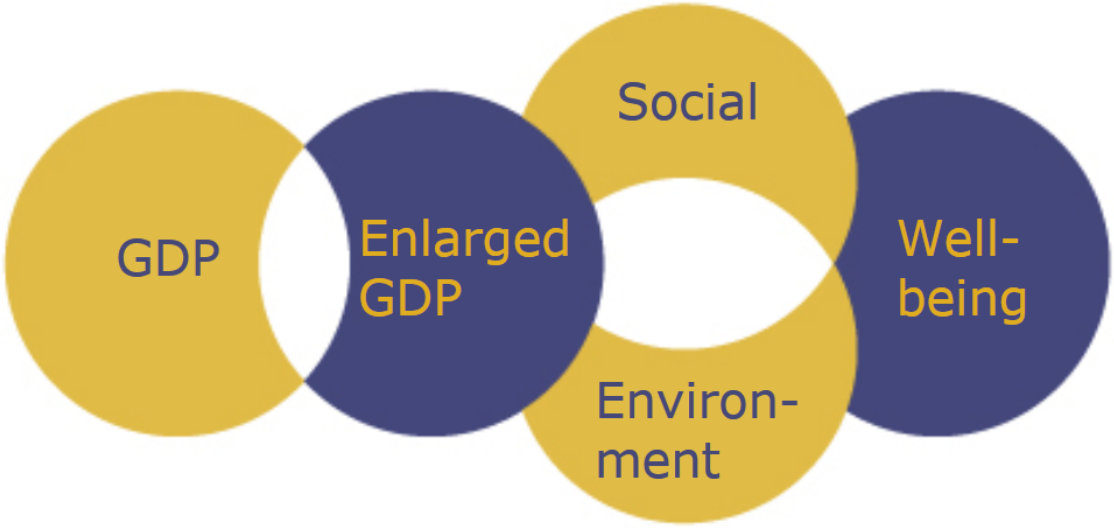

Image 3: Five dimensions to indicators (Source: European Commission, Beyond GDP project)

The Beyond GDP typology, notably, hides issues such as energy, material flows or cultural issues and adheres rather strictly with the triple-bottom-line thinking. In the Beyond GDP classification, the dimensions seem to overlap, and it has been seen that different indicator proposals can possibly belong into more than one category. Baster (1985, 38–43; cited in Booysen 2002) claims that development indicators differ according to the different views on the meaning that individual researchers ascribe to development.

Solely on the basis of the indicator description and naming, the policy-maker might have difficulty in distinguishing how it has actually been constructed (Davis et al. 2011; Mayer 2008). Other studies show that also the general public feels that it is receiving conflicting information about sustainable development, especially with regard to the environmental aspects (EEA 2006; Hardi and de Souza-Huletey 2000). In finding suitable indicators for sustainable development, there are different choices of framing to achieve maximum validity and reliability, and there is a long history

of demands of consistency of indicators. Drewnowski (1972, 77) called for ordering principles for the selection of indicators and rejection of ill-conceived and inapplicable ones; Wish (1986) for a systematic rationale; and Prasad (2004) a sound methodology as well as indicators that would be easy to understand by experts and non-experts alike (See: Booysen 2002). From a technical viewpoint, Dale and Polasky (2007, 289-290) have demanded indicators to be: anticipatory of changes, easily measured, predictable in their behaviour, predict changes to allow management, sensitive to changes in the system, and to have known variability. Booysen (2002) wishes that indices were simple and manageable but complains about a lack of hard rules for identifying indices that are 'simplistic yet substantive and informative'.

Finally, it is worth keeping in mind the conceptual difference between development indicators, environmental indicators and the indicators of sustainable development – all of which will be discussed in this paper accordingly. The literature, however, is at times perhaps a bit overlapping in terminology and therefore also might cause confusion. Because of the active academic debate around SDIs and their high political significance, it is possible that in the future, either more attention will be given to the existing indicator proposals or that new indicators will emerge in the future. Today, there is already a plethora of indicators to choose from (see e.g.: Talberth 2008; Mayer 2008; Gennari 2007; Booysen 2002), but noting the problems on agreeing about the ends and means of sustainable development, it is understandable that people are asking what is actually a genuine bottom-line. Another challenge concerns data, and in general, SDIs have been forced to accept broad types of data in order to achieve comparable performance measurement with "natural (theoretical) inconsistencies, gaps, mismatching, and difficulties with meaningful disaggregation" (Hardi and DeSouza-Huletey 2000, 62). Traditionally, measurability and international comparability have prevailed in the indicator selection criteria (Niemeijer and de Groot 2008).

3.3 The challenge of missing data

It is worth bearing in mind that perfect information is almost never available. Throughout history, statisticians have suffered from the problem of missing data – even Kuznets (1934) when presenting his first economic efforts to estimate U.S. national GDP accounts. Furthermore, the argument about the lack of sufficient data is also a powerful political argument against science (Taylor and Buttel 1992). In terms of data collection, though, missing observations as such may not be an issue because statistical techniques can be employed to tackle data issues in the analysis phase. In addition, a certain amount of uncertainty is in any research an inevitable part of scientific endeavour.

Some cross-country analyses also deliberately exclude authoritarian regimes and centrally planned economies, or only include countries with a large enough population (Booysen 2002). In addition, development or poverty indices have tended to exclude industrialised countries because their inclusion has been considered largely irrelevant. Of course, in some instances might be unnecessary and interesting results could also be found beyond the original target group. A genuine concern, though, specifically for developing countries is the issue of data collection and the low statistical capacity of the public institutions, which as such can pose serious problems (Jerven 2013). After all, even in many industrialised countries conducting a national census alone is a relatively expensive and time-consuming exercise. Efforts to collect more data can be expensive, take long periods of time and make organisations consider trade-offs between spending their resources to collect further data or make better use of already existing data and its marketing (Knight et al. 2010). The lack of data has been considered a major challenge especially in terms of the quantification of the environmental dimension, and undermined efforts of environmental management and systematic conservation. Data gaps exist in a number of important issues such as chemicals, waste and freshwater pollution, and in such areas it has been difficult to measure progress towards goals (UNEP 2012), even if environmental accounts would be crucial for the estimation of natural capital (Hicks 2011).

The lack of environmental time-series data for the purpose of international comparison and long-term trends is often mentioned as one of the main limitations to operationalise SDIs. Recently, Hsu et al. (2012) attempted to adapt their measure to construct a national EPI index for China, but had to stop short due to poor data and weak measurement systems locally. For similar reasons, Moffatt (2008) omitted Russia in his comparative study about the performance of G7 countries in the light of different SDIs. The EPI authors (Yale 2012) also complain about a lack of global, accurate data on waste, recycling, toxic exposures and other policy concerns; or low quality of data on agricultural sustainability and water quality and quantity (see also: UNEP 2012). In a comparative study of SDIs, Pineda (2012) considered only a few indicators to have satisfactory data over a relatively long period of time. But perhaps there is also a need for more internal coherence within science itself, for at least Niemeijer and de Groot (2008) have demanded a more organised and transparent selection process of environmental indicators. This could also enable better environmental management as suggested by a UNEP study (2012b, 31), which notes that typically there has been more progress on those environmental goals that have been linked to measurable targets.

Of course, in addition to such practical and methodological challenges, some data sources have simply been kept confidential by governments, police or private agencies, even if such data would be important for the SD assessment (Hardi and DeSouza-Huletey 2000). And in the worst case, there have also been deliberate political attempts to obstruct the publication of certain figures, or data publishing might even be subject to misuse or deliberate fraud[15]. In the early 2000s, having introduced the Green GDP, which subtracts the approximated value of environmental degradation from economic productivity (GDP), China stopped its measurement after pressure from local governors, even if the difference in the 'actual' and 'green' GDP was hardly more than a few percentage points. Controversy over the policy implications of the results could induce reluctance towards the adoption of new accounting techniques, something that occurred with the introduction of fisheries accounting in Chile (for details, see: Lange 2003, 15). When statisticians are following new statistical trends, they need to protect the public interest even when their findings become subject to political pressure from the state administration or other stakeholders (Hauser 1973, 68-69).

An increased demand for the openness of data may partially enable the accountability of decision-makers accountable. To date, some information has simply not been made available for the public, even if it was essential for decision-making. The U.S. Environmental Protection Agency only released national GHG data available for public scrutiny in 2012 (US EPA 2012), and McCright and Dunlap (2010, 114-116) even suggest that during the George W. Bush administration (2001-2009), the national *State of the Environment* reports were censored to emphasise climate sceptical reports over mainstream science with some of the scientific reports having withdrawn from the Internet. In the U.S., the EPA is not the only example of a state administrative body falling under political influence. In the 1970s, the Nixon administration deliberately restricted or decided not to continue the publication of certain social indicators (Cobb and Rixford 1998, 11). But there are other countries too, and also other types of data can be withheld or even forged. As recently as in 2011, the government of Argentina was caught of the publication of false inflation rates for several months (The Economist 2011). When the international financial institutions noted this, they changed to an alternative data source.

Finally, future outlooks and scenarios with embedded assumptions subject to varying calculation techniques that dominate policy forecasts should be held subject to critique, especially when they

are published by the industry. For instance energy figures are mostly published by private actors. Interestingly though, in the energy sector there is actually evidence of also countries misreporting the figures of their oil reserves (see also: Gautier 2008, 88–92; Global Witness 2009). Perhaps some issues are simply sensitive and related to economic interests. Nevertheless, often times models and figures at least typically serve to indicate the magnitude and certainty of a current situation, as confidence levels outline both lower- and higher-end scenarios. In the case of Germany, the energy projections in the IEA World Energy Outlook 1996 that were made to the year 2010 have proved to be accurate within a 2.5% margin (IEA 2012). And what is more, model reliability can be improved over time and with additional resources (Oreskes and Belitz 2001, 26). For instance, in the 1990s, the climate change worry was subject to more scientific uncertainty than in our time. The first IPCC Assessment Report (1990) concluded "unequivocal detection not likely for a decade". The increase of scientific certainty can be found from the development of the understanding in the scientific community: in 2001, the third IPCC Assessment Report already considered climate change *likely* in statistical terms; and AR4 found it *very likely* (IPCC 2007; Oreskes 2004). The most recent IPCC Assessment Report AR5 now states it *extremely likely* (IPCC 2013) that human influence has been the dominant cause of global warming since 1950, and that warming of the atmosphere and ocean system is *unequivocal*. Increased certainty can persuade more sturdy political action because it counters the ability of non-scientific evidence to win prevailing arguments.

3.4 Analysis: Strong and weak sustainability

Overall, it may be assumed that researchers working with SDIs could be positioned into a trajectory and in its ends lie two opposing groups: those who have assumed an explictly *ecocentric* epistemological position and those that have adapted to more *anthropocentric* positions. An ecocentric approach primarily adheres to the evidence-basis of natural sciences and its concerns about ecological thresholds, and in a hierarchy, economic performance is secondary to concerns defined by physics and natural science. In turn, the anthropocentric stance attempts to operate within the logic of human societies and economics as well as the monetary economy to better incorporate ecological views. The challenge of anthropocentric views, however, is their tendency to underscore the economic logic over ecological concerns, and in turn, the problem of ecocentric views is how to adapt these same concerns to the logic and conventions of human societies.

In the literature, SDIs are often divided based on whether they adhere to the principles of strong sustainability or weak sustainability. Traditionally, those indicators that are considered to follow the principle of *strong sustainability* are considered to assume the hypothesis of ecological thresholds

and the fact that ecological well-being must precede economic well-being. Ecology can be argued to be valuable or even irreplaceable, for in the case of many ecosystems, if they are lost or damaged, it can be difficult, costly, or even impossible to replace the damage that has been done (Defra 2012). The negative impacts may, for instance, concern the disruption of natural cycles that can have further consequences, or the loss of rare species that cannot be brought back. Therefore, it is argued that there are very limited opportunities to substitute natural capital with other types of capital. *Weak sustainability*, in turn and indicators that follow such a position, accepts substitutability between different types of capital (Stiglitz-Sen-Fitoussi 2009; Moffatt 2008; Neumayer 2003). This means that, if the weighing is conducted 'appropriately', decreases in natural capital for instance, could simply be offset by an increase in physical or human capital (Stiglitz-Sen-Fitoussi 2009). Seemingly, this also allows the making of trade-offs that are harmful for the environment.

Systems of 'green accounting' are also systems of weak sustainability. While they attempt to adapt to the ecological dimension, like all economic actors, such accounting systems need to respect the terms of the monetary economy, in which the bottom-line is to avoid *economic debt*. They have been criticised because even if non-monetary aspects such as the environment or well-being were incorporated in the accounting, the modelling of the ecology may be inadequate, and simply using a monetary-based approach, it may be impossible to substantiate ecological thresholds or monetise elements that ultimately are considered priceless (Moffatt 2008; Wackernagel and Rees 1996). Some suggest that using green accounting systems could make the economy more ecologically and socially sustainable by changing existing patterns of thinking about economic gains.

Composite indices that attempt to construct a balance between *all* the three SD dimensions to strike a 'win-win-win' balance have been theoretically criticised for the use of subjective judgment and of being seemingly ideological statements rather than practically functional indicators (Booysen 2002, 146). There is some point in this criticism, as composite indices can include any dimensions and sub-indicators the researcher wants it to incorporate. However, it can also be argued that the weighing of certain dimensions over others may be necessary in order for the indicator to manufacture a meaningful overall score to communicate a message it theoretically says it aims to represent. Like additive indicators, composite indices incorporate other dimensions than the economy and, unfortunately, similarly also struggle to make ecological thresholds visible (Neumayer 2000). Combining environmental, social and economic items in one single indicator may be undesirable because the dimensions are often in conflict with one another, and instead of

"generating fog on the road to a sustainable production level", Hueting and Reijnders (2004, 259), advocate for a clear division of labour between environmental science, social theory and economic theory.

Canoy and Lerais (2007) have compared the quest of 'a proper indicator' to "the search of the Holy Grail" and propose that different indicators cater for different purposes. Scoones (2007) considers sustainability a 'boundary term' that connects different groups to a common agenda, even if in reality the task of matchmaking environmental and developmental considerations is often challenging. According to Hueting (2013, 83), reports about sustainable development since *Our Common Future* have implicitly accepted conflicting goals to endorse production growth while also demanding sustainability. In the dawn of the first environmental concerns in the late 1960s and early 1970s, prior to the inception of the notion of SD, views that attempted to fit environment and development in the same equation were highly contested. Therefore, at the onset SD was judged as a "contradiction in terms" (Georgescu-Roegen 1993; O'Riordan 1985). After some decades, though, the debate is more elaborate as awareness of environmental challenges and constraints has expanded, and many rather see SD as an ideal of an integrative approach. However, those with a critical view to SD consider that instead of driving transformational change, SD has rather legitimised economic growth in the context of environmental protection (Bernstein 2002, 4). Newell and Paterson (2010, 24) emphasise how free-market principles have dominated and limited the availability of policies for environmental considerations in recent international politics. And, these indicators only implicitly address the issue of energy and resource consumption. The challenge of a transformative concept is connected to the expectations it must carry. In the worst case, expectations of consistency and coherence within a chosen discourse may lead to "rhetorical entrapment" (Schimmelfennig 2001) where political actors feel obliged to follow the policy implications of discourses they have accepted in the past in spite of pragmatic challenges and diverging actual preferences. According to Schmidt (2008, 311), this explains well why discourse is *more than talk*. Paradigms not only commit politicians into actions, but also constrain actions of their successors, future ideas, and discourse. However, existing paradigms and measurement efforts are constantly challenged by societal development that contextualises what is considered right, wrong – or sustainable.

Quentin Skinner (1998) emphasises that concepts should always be evaluated in relation to their historical and political context. All in all, for a common person, the notion of sustainable development and the SDIs remain somewhat abstract, which is understandable not only because of

certain data gaps, but they operate in the war field of international politics and institutional interests. Yet, at the same time, SD also symbolises an attempt to escape this rigid field. This chapter has outlined issues regarding the formulation of sustainable development (H_1) and argued that because the power of information lies in the cascades and representation (Latour 1987, 241), there are multiple ways to adapt to this notion. The next chapter argues that in the interface of science, politics and society; theoretical progress in the field of social science and statistics influences the construction of indicators, and consequently also the attempts to manufacture SDIs (H_2). In order to examine this claim, we contextualise the theory of sustainable development against bottom-lines of different dimensions that together may be argued to constitute the foundation upon which sustainable development, or an ideal of ecological and human well-being, lays on. Such a method, in my view, makes it possible to genuinely de-construct the knowledge structures that frame and underpin any measurement efforts to sustainable development.

4. Does scientific progress enable increased governance?

This chapter assesses how scientific knowledge has influenced the construction process of indicators in the past, and sees what underlying assumptions and bottom-lines must also researchers constructing SDIs take into consideration. This methodology resembles an enthusiasm shared by Foucault in 'The Archaeology of Knowledge' (1969) and 'The Order of Things' (1966) where he was keen to understand and elaborate the contexts where knowledge had been formed. The chapter uses a chronological review that illustrates how statistical measurement techniques have historically developed, even if such a methodological choice has certain limitations. First of all, a time-based narrative struggles to live up to the SD typology of three dominant (environmental, social and economic) dimensions. Here, development indicators *and* the indicators of happiness have been dissociated from the review of social indicators. However, in practice such a choice may be deemed highly artificial. Furthermore, in this chapter the GDP is used as a kind of a mirror that reflects changes in the measurement thinking. Even if it may receive too much emphasis, this choice partly adheres to the imperative of the monetary economy and current measurement understanding. Then, in the environment chapter, the issue of climate change is discussed more thoroughly than other issues, which I argue that for its urgency, it deserves a more careful assessment. Finally, there are evidently a number of other components that may be argued fundamental to the well-being of societies (peace, security, political rule, rights, culture or religion). However, within our scope, they can only be given limited attention, and after all, this adheres also to the limitations of the notion of SD itself.

4.1 GDP and the economic numbers

"Knowledge is our most powerful engine of production; it enables us to subdue Nature and force her to satisfy our wants."

(Marshall, 1890, Book IV, Chapter I)

The world of financial decision-making is dominated by the work of econometricians with indices of stocks and prices (Dow Jones Industrial Average Index, Nikkei 225 Index, MSCI World Index, IMF Commodity Price Index, et cetera). While the discipline of economics has become ruled by a strong mathematic fashion with a fascination in figures and indices (see: e.g. Fox 2009) relying on modelling and aggregation; according to critics, these same figures and economic modelling operate in isolation from other scientific models and areas of knowledge while nonetheless enjoying a hegemonic position over other knowledge structures.

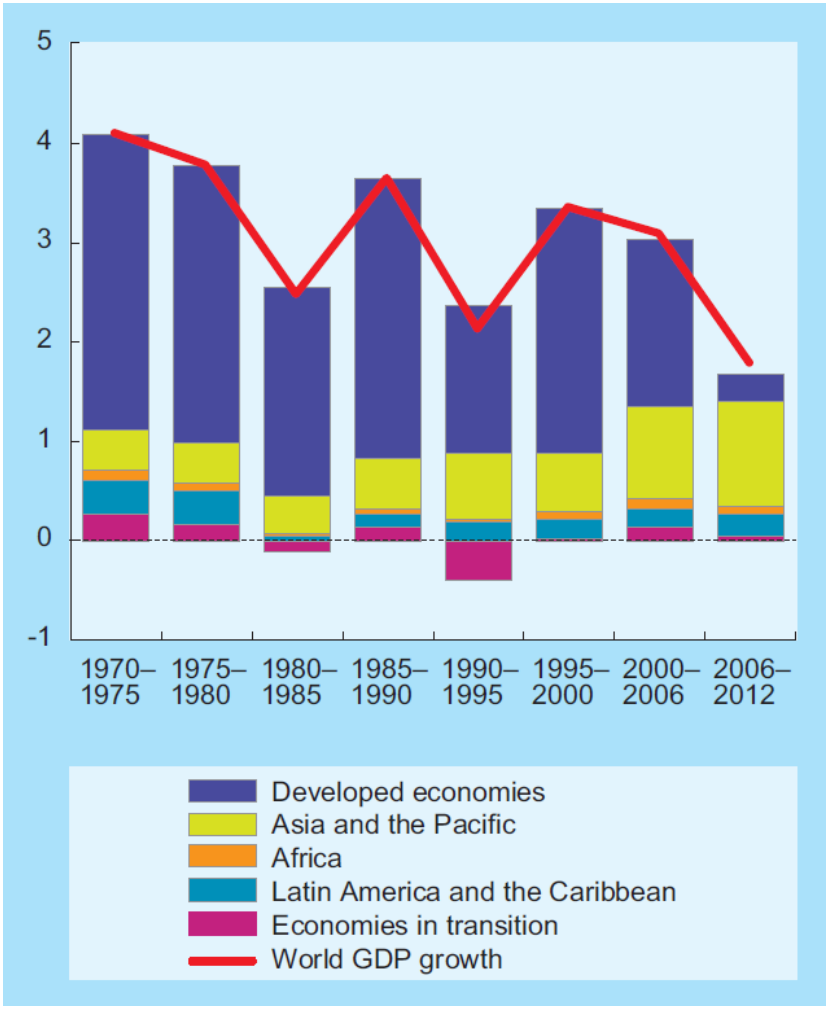

Image 4: Annual GDP growth (per cent) per region and globally 1970–2012 (Source: UNCTAD 2012).

The current world GDP is around USD 71.9 trillion (WDI 2013). Since the 1970s, the 'developed economies' or the Western countries have been the ones mainly driving economic growth, even if the Asian Tigers emerged in the latter part of the 20th century following the East Asian Miracle. Elsewhere (Latin America, the Caribbean and Africa), growth has been more modest. More recently, China with its resource demand (see: e.g. Moyo 2012) has taken the lead, followed by other BRICS countries, while the Western economies have become stagnated by an economic crisis that has hindered growth from 2008 onwards (*Image 4)*.

Economic growth is the driver for *material well-being* (Aghion and Howitt 2008; Maddison 2005b, 2005a), and thus argued of being a good proxy for well-being overall. To describe the expansion of the world economy or the material basis of well-being, during the last millennium the absolute GDP increase was 300-fold and per capita income increase 14-fold (Maddison 2005a, 5). Economic

growth, measured in GDP, has typically been depicted as the catalyst of development, achieved thanks to technological development and improvements in human capital, resulting in huge increases in physical capital of machinery, equipment and infrastructure (ibid.). Aghion and Howitt (2008) list four ideal types that explain economic growth: the neoclassical model, the AK model, the product-variety model and the Schumpeterian model, which mainly focus either on capital accumulation, or innovations that have increased productivity as explanatory factors. For almost all countries, there is time-series economic data on output, capital and labour (Aghion and Howitt 2008, 107).

While the GDP is still mainly employed as the most central figure of economic performance, the arguments accumulated over the years against the technical and structural deficiencies of the GDP make an extensive list (e.g. Michaelson et al 2009; Stiglitz-Sen-Fitoussi 2009; van den Bergh 2009; Rifkin 2004; Daly and Cobb 1989). Practical examples illustrate some of them: in the 2000s, Sudan enjoyed sustained economic growth in spite of a severe humanitarian crisis and drought; in the U.S. in 2005, the GDP showed positive figures in spite of hurricane Katrina that caused over a thousand deaths and economic losses estimated at USD 108 billion (NHC 2005). Another case in point is oil-based growth that has allegedly been prone to cause 'Dutch disease' or 'resource curse', as extensively debated by economists (see e.g. Collier 2007; Dietz et al. 2007, World Bank 2008). Indeed, there are very modest rates of aggregate well-being in the countries endowed with natural resources such as Algeria, Angola, Bahrain, Cameroon, DR Congo, Gabon, Iraq, Libya, Nigeria, Oman, Qatar, Saudi Arabia or Yemen (WDI 2012, 170-173), as quite a few oil-rich exporters of energy have been rather unsuccessful of re-investing their money for the benefit of wider economic development or the broader lifting of social standards (see also: Frankel 2010). So, if the world is looking at the GDP as the basis of economic and political decision-making, what is it actually looking at?

The GDP assembles the total sum value of produced goods and services of a certain area over a defined period of time. In the case of a nation-state or a city, the total sum of goods and services produced in this area is quantified and expressed either as a total sum or as a per capita average. For technical reasons, minor adjustments can be made to the GDP: *i)* The real GDP adjusts for inflation while the nominal GDP does not; *ii)* National-level calculations in local currencies are typically converted to USD and GDP is also often corrected with purchasing power parity (PPP) to correct for inter-country price differences in order to permit meaningful comparisons of the levels of real output and expenditure (Maddison 2005b, 2); *iii)* The GNP, gross national product, similarly

expresses a total market value of all products and services but allocates the production based on ownership, not geographic location[16]; *iv)* The GNI, gross national income accounts for the flows in and out of the country[17]. It is worth of course mentioning that beyond the GDP and its variants, there is a large group of other economic indicators. They can be divided into flow and stock measures[18]: the GDP, income, investment, saving or spending are flow measures; whereas capital, financial assets, inventories, liabilities and wealth are stock measures. The GDP, for instance, is a flow measure because the rate of GDP is measured per unit of time typically over a period of year[19], whereas stock measures quantify levels into a defined point in time. So looking at the GDP basically pays attention to economic flows and production.

In doing so, the GDP fails to clearly divide costs and benefits; correct for changes in stocks and supplies; capture all social costs *or* the intertemporal dimension of economic decisions; also fails to acknowledge that basic needs cannot be changed to material goods; acknowledge income distribution and rivalry for status; account for the informal economy or the externalities or depletion of natural resources; and finally, the GDP does not equate with happiness[20] and paradoxically counts defensive expenditures such as military or pollution clean-up as positive contributions[21] (Van den Bergh 2009, 118-119). Also, a countless number of economists over the years have emphasised that the GDP, contrary to the common belief, was never even intended as a well-being measure[22]. Rather, it has only assumed such a position. The centrality of the GDP can be argued to be significant because it frames and guides political decision-making. For instance, the World Bank primarily employs the GNI per capita measure[23]; and the U.S. has employed the GDP as its primary economic measure since 1991, with both of them prior users of the GNP. We will next examine and assess the position of the GDP in a historical context.

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[16] The GNP counts all the production by companies of a certain country regardless whether the companies are located home or overseas, whereas the GDP calculates what is produced within a country's boundaries regardless who owns the companies. This can also be expressed as a following equation: GNP = GDP + Net property income from abroad

[17] GNI is similar to gross national product (GNP) except that the GNP does not account for indirect business taxes. Countries like Ireland or Luxembourg, which host a lot of foreign investment have a considerably lower GNP than GDP because the investment flows back to the host multinationals, which are outside the country's own borders.

[18] Certain other economic indicators include: capital flows, commodity prices (eg. food, oil, metal prices), consumer prices (CPI), credit, debt rates (public debt etc.), debt-to-GDP-ratio, employment rate, foreign direct investment, GDP, global trade, innovation, import/export ratio, inflation, interest rate, investment rate, oil price, stock prices, tax rates

[19] For instance, USD per year per capita

[20] The wider historical discussion about economic growth figures extends beyond the GDP critique with the likes of Galbraith (1958) that emphasised the psychology of relative poverty for people in a community; and Polanyi (1944) who criticised economic growth for viewing land merely as an exploitable good (see also: Väätäinen 2005)

[21] A famous case in point is the 1989 clean-up of Exxon Valdez oil spill, a major environmental catastrophe

[22] Over the decades the likes of Simon Kutzets, John Kenneth Galbraith, Paul Samuelson, William Nordhaus and James Tobin, Amartya Sen, Herman Daly and Partha Dasgupta have criticised the GDP, see: van den Bergh (2009)

[23] In calculating the GNI and GNI per capita, World Bank uses its 'Atlas conversion factor' to reduce the impact of the fluctuation of exchange rates

So, I claim that history can explain some of the reasons why societies and the entire profession of economics are so intimately linked with the growth effect, symbolised by the GDP. The first explanation concerns the emergence of modern economics, which grew as a 'handmaiden' to the industrial revolution (Diener and Seligman 2004, 2). In the 17th century William Petty started the initial estimates of national accounts, and in the following centuries, classical political economy engaged philosophers and economists from Adam Smith and David Ricardo to Karl Marx to focus on the theories of the industrial economy. Alfred Marshall's *Principles of Economics* that was published in 1890 summarises the intellectual foundation of its era: economics, according to Marshall, deals mainly with issues such as wealth, capital, labour, production and consumption. The likes of Foucault (1966) have been perplexed by the pace of this transformation and how quickly political economy established itself in the nineteenth century.

A slightly more contemporary explanation then describes how in the 20th century political economy gradually transformed and institutionalised from the epistemological foundation described above into modern economics, not least thanks to the extensive theoretical progress in the works of macroeconomists (Fox 2009) such as John Maynard Keynes and Simon Kuznets, both of whom also gained widespread reputation in the field of public policy. In the 1930s, theoretical interest into determining the size of the economy arose in many frontiers simultaneously as the GDP was boosted to become a central measure of the state. Famous economists across the Western world worked tirelessly: Jan Tinbergen worked on national accounts in the Netherlands; Jean Monnet commissioned a "balance sheet" of the French economy (Vanoli 2005); and in the U.S, Simon Kuznets (1934) conducted a breakdown per industry and income category to assemble the gross domestic product. There is something to be noted about the era as well. In the UK, British economists Richard Stone, James Meade and John Maynard Keynes were motivated to construct the GDP accounts as they were tasked by the British government to learn, whether the World War II would be economically viable. Eventually, they concluded that the war would have a positive net effect on the UK national growth rate. Some researchers (Talberth et al. 2007; Studenski 1958) have emphasised this connection to perhaps make explicit why it seems concerning that theoretical views are supported in which wars can be displayed in a seemingly positive light in relation to the national economy, of which the politicians then decide upon. Indeed, wars can benefit the national economy in the shape of the growth of the military industry and the employment effect.

The consequent and perhaps most compelling explanation to contextualise the GDP better in our

current understanding is related to the significance of the GDP in the post-war recovery period. For countries most of which were recovering from the Second World War, learning about the management of their economies was most useful. Richard Stone, one of the economists that had worked closely with the GDP has been mentioned to have good personal connections with the international organisations. The work on national accounts was adopted by international organisations, and Stone personally was involved with the OEEC (that later would be known as the OECD), initially founded to administer American Marshall Aid to Europe. The United Nations soon followed and in the 1950s, countries adopted a newly established UN System of National Accounts (SNA) whose purpose was to outline an internationally agreed set of recommendations on how to compile measures of economic activity (UN 2013a; WAVES 2012, 4)[24]. In a rather short period of time, the GDP has gained universal acceptance even if, of course the management of the economy surely runs longer back in human history. Nonetheless, today, the world is full of accountants educated in monetary accounting whereas prior to the 19th century such a profession hardly existed (Porter 1992, 641).

Bennholdt-Thomsen and Mies (1999) call the accounting for the nominal GDP that only grasps the formal economy *the iceberg model of capitalist patriarchal economies*, in which only the visible economy is communicated and the invisible parts of economy remain hidden (Henderson 1982). A focus of the state on aggregate growth struggles to acknowledge the immense amount of activities beyond the formal economy from domestic or household work done by women to subsistence farming by small-scale peasants and those in the informal sector beyond wage labour (Bennholdt-Thomsen and Mies 1999). A relatively recent study estimated that the informal economy could account for 44% of the GDP in developing nations, 30% in transition economies, and 16% in OECD economies (Schneider and Enste 2002).

In a narrow sense, the GDP may merely be viewed as nothing more than the sum of certain types of observations, consisting of the transactions of economic activity. But in a broad sense, the GDP may also be viewed as a powerful symbol embedded within the knowledge discourse of the dominant economic theory (Samuels 1990). This can be argued to be significant because in spite of increasing pluralism in economic studies (Davis 2006) or suggestions that neoclassical economics has lost its leadership as the mainstream narrative in economic studies or even to have 'died'

[24] For a comprehensive discussion about the history of the development of national accounts, see: Studenski (1958)

(Colander 2000)[25], academic curricula and textbooks *remain* strongly based on these grounds (Raworth 2012b, ibid.). Furthermore, many of these economists later become policy-makers. Operating in an allegedly reductionist world of econometric models seems to support the accumulation of knowledge structures where the wealth is analysed mainly from a rather conventional perspective. There has been intense theoretical development within the economic discipline and later finance (Fox 2009), but it may be suggested that a lack of an intellectual linkage with other academic disciplines combined with the simultaneous dominance of economics in formal policy-making in the state machinery limits the views of alternative considerations.

Decision-making based on the monetary figures only largely ignores the structural factors that shape economies such as the access to information, moral, psychology and institutions such as states (Mellor 2010). Some suggest that an impersonal, number-oriented, profit-seeking accounting has employed an effective tyranny (Porter 1992) and might have weakened the opportunities to limit the accumulation of wealth in the hands of the few (e.g. Ngwakwe 2012). In the recent light of growing inequalities (Milanovic 2013), such claims might have grounds to make an increasingly convincing argument. From the climate change perspective, economic figures remain silent on material and energy consumption (Daly 1996, Georgescu-Roegen 1993). Attaching value to economic concepts has made it possible to measure the market value of land or labour whereas the valuation of social, environmental and cultural phenomenon is more difficult. Economic figures that are constructed in a particular way may be suggested to constantly renew themselves in order to maintain their position in societies that follow their guidance. For these reasons, it is necessary to discuss about measurement instruments that go beyond the economic perspective[26].

4.2 Emergence of well-being indicators in the 1960s and 1970s

"The welfare of a nation can scarcely be inferred from a measurement of national income".
(Simon Kuznets on GDP and well-being in 1934)

There are, of course, non-monetary indicators, and the early history of social indicators begins with statistical indicators being taken into use in the 1800s in Scandinavia and countries like Belgium, France, England, and the U.S., aiming to improve public health and social conditions. In the early

[25] The development of economics as a scientific discipline over the course of the 20th century has been well documented (See: e.g. Fox 2009)
[26] For a debate of ecological economics and neoclassical economics, see: Davis (2006); Daly (1996); Keita (1992); Daly and Cobb (1989)

20th century, the Russell Sage Foundation in the U.S. initiated "community indicators". The first official publication called *Recent Social Trends* about social measurement was seen in the 1930s (Cobb and Rixford 1998). However, social indicators only seriously started to gain ground in the West in the 1960s (Atkinson and Hamilton 1996) with the emergence of the welfare state. As argued by Nissel in the United Kingdom of 1970s, economic progress should be measured "in part at least, in terms of social benefits". Such claims finally also academically argued that economic growth *per se* does not guarantee an equal distribution of wealth, an observation, which made a branch of philosophers, economists and political scientists to steer towards egalitarianism (Hicks 2011).

Welfare, in economic terminology, is a social welfare function, an aggregation of individual utility functions. In the utility theory, welfare equates with the maximisation of utility that is quantified on the basis of all the utility functions aggregated from the preferences of individuals (see e.g. Atkinson 1970). However, policy-wise the targets of equity and the well-being of *all* people imply that also income distribution and deprivation must be measured (Fukuda-Parr 2003). For Putnam (2001b, 2001a), well-being is associated with social capital, or having people prospering in neighbourhoods where they trust and mutually help each other; and from the psychological viewpoint (Seligman 2002) well-being is rather associated with life satisfaction and issues such as pleasure, engagement and meaning. Non-monetary indicators measure social performance and there is good agreement about quite a few basic social targets[27]. Security and low crime rates are typically valued across societies, and also health and education are perceived as *means* and *ends* that together constitute the basis of well-being compared to income that only looks at means.

Social achievement or conditions can be evaluated through a technique of de-construction of the different components that are perceived to constitute social success. Educational attainment, for instance, can be measured and de-constructed by looking at quantitative aspects such as enrolment rates or the number of teaching staff, or qualitative aspects such as the quality of education proved by literacy rates, employment rates after graduation, and so on. To give another example, the role of income inequality has been a focal point of debate, as different societies seem to have different levels of tolerance for inequality (Graham 2005). Gini coefficient has been the principal measure of

[27] Certain social indicators: Child mortality, education and training rate, crime rate, day care provision for children, democracy, employment rate, ethnic disparities, gender equality, integration of foreigners, job satisfaction, income inequality (Gini coefficient), life satisfaction (or subjective well-being), literacy rate, maternal mortality, minority rights, obesity (non-communicable diseases), pleasure, premature mortality, political freedom, public health expenditure, smoking rates, social capital, social integration, urban – rural disparities

income inequality, interpreted as social welfare loss due to inequality (Xu 2004)[28]. Gini coefficient has minimum and maximum values [0,1] theoretically depicting a society where there is no income inequality to a completely unequal society. The degree of income inequality should not exceed what is deemed ethically acceptable even if a society of no income equality may not be possible (Lawn and Sanders 1999). Graham (2005) criticises Gini coefficients as static, aggregate measures that do not change much over time, and do not usually reflect distributional shifts among regions or skill cohorts. Gini also fails to advise what would be an optimal level of inequality. The Atkinson index (Atkinson 1970) is an alternative measure to income inequality, a measure of the society's aversion to inequality, making the researcher to explain the assumption on this rate (Neumayer 2000). In social issues, individual indicators have also been extrapolated and helped build social indices. Gini coefficient has been used for estimates on social issues such as income mobility, education and opportunities, resulting in various indices such as the *Shorrocks mobility index* (Shorrocks 1978; Prais 1955), *Education Gini Index* (Thomas et al. 2000), *HOI, Human Opportunity Index* (Barros et al. 2011, 2009) or *IEO, Index of inequality of economic opportunity* (Brunori et al. 2013). Perhaps to give a concrete example from the area of global health, these days the World Health Organisation publishes a System of National Health Accounts in order to provide evidence-based information on health trends (See: SHA 2011).

Nonetheless, agreeing on the significance of certain social indicators has been more difficult than others because of different value assumptions prone to vary in cultural contexts. It may be difficult to agree what is the appropriate weight for a selected issue that contributes to well-being. While universalism believes in a set of values considered to apply for all human beings, cultural belief-systems determine how different values are articulated. Even if societies in general might be more sensitive in reacting towards certain issues such as inequality in relation to children's rights or access to healthcare (Tobin 1970; cited in Yitzhaki and Schechtman 2013) than other perceived injustices, this can have an impact on issues such as the extent of human rights. Beyond quantification as an academic technique, it is fair to say that the employment of most social indicators has gained acceptance through social transformation. Democracy, gender equality, human rights or political freedom and other social achievements are in many ways results of political action. However, here indicators themselves have played an important part. Civic rights groups have systematically gathered evidence to popularise issues to make known the 'wrongs' in a

[28] Corrado Gini's conceptualisations (1921, 1914, 1912) later provided grounds for later theories such as Amartya Sen's work on poverty. In order to compare income inequality during a certain period, the year with the lowest inequality is taken as the base year, after which the other years are indexed against the base year. On the methodology of gini coefficient, see: Xu 2004, Neumayer 2000.

society such as the right for shorter working days, which was amongst the most important social goals in the 20th century in the West. After the feminist revolution made path to the advancement of women, gender-aggregated data, for instance, enables the follow-up of information on gender inequalities. Education, health and unemployment figures have been integral to the debates on economic and social policy. Currently, youth unemployment figures are raised as a concern both in developed and developing countries. Social theories, in addition to evidently being a starting point to a social debate, influence judgment over indicators. In the case of income inequality, those on the political left have typically considered income inequality a negative trait, and those politically more in the right bear a higher tolerance of income disparities. Comparisons between the U.S. and the Nordic model, for instance, exemplify such differences. Still today, the significance of income inequality for the well-being of a society remains a key point of debate. In the Western world, the political left-right axis has accentuated the arguments over ends, means and ideals, correct economic and social policies, and the role of state.

In social policy, the numerical strategy has been a rather efficient means of argumentation. Veenhoven (1996) favours ends-based measures because they can be related to policy goals. Evidently, social goals are affected (at least) by the contextualising factors of time, political landscape and culture. Previously, smoking was long considered a symbol of liberty and a right before its adverse health risks became known. But not only did smoking become considered a moral hazard, the state soon understood that it bear a major public health cost, and the reduction of public health expenditure of course makes a powerful argument. Also issues of environmental health (better air quality, sustainable cities) seem to provide economic, social and environmental gains. Of course, formulating an economic cost-benefit analysis of certain types of government investments such as arts, music, sports or parks as cultural services is more difficult than demonstrating the economic value and also for these reasons a non-monetary logic must be applied. However, such activities may or even plausibly can create indirect economic benefits and the typology of *intrinsic* and *instrumental* value exemplifies the difference. While cultural services may be considered to have intrinsic value, instrumentally they also create economic activity and linkages with the surrounding economy. However, while advising government policy may become easier when economic returns are visible, some might sceptically argue that before such benefits are made explicit, it is difficult to credibly advance any cause at all.

Then again, some issues have remained apolitical because they are morally or culturally sensitive. Population growth, for one, is a fundamental driver of environmental pressure, with future trends

highly dependent on fertility rates (UN DESA 2013). Many Western countries are already peaking, but in the 20th century, the world population quadrupled mainly due to declining death rates. The UN projects 9.6 billion people in 2050; and a population peak at 10.9 billion in 2100 (UN DESA 2013); whereas Munoz et al. (2013) suggest the world population to peak already by the middle of the 21st century[29]. In 2013, the 49 least developed countries (LDCs) have the fastest growing populations in the world at a 2.3% average per year. While globally the population will live longer, the proportion of youth population will remain high in many developing countries. Half of the future population growth is expected to occur in only eight countries: Nigeria, India, Tanzania, DR Congo, Niger, Uganda, Ethiopia and the U.S. (ibid.).

In summary, the evidence of the power of numbers in social issues is mixed. Social analysis has both independently evaluated the social situation with non-monetary indicators as well as contrasted these ends-based measures with economic indicators (Booysen 2002). Compared to national aggregates, the study of intra-country social disparities helps in a more detailed identification of *all* people's well-being, and household data in particular brings statistics closer to the governed. Cobb and Rixford (1998) claim that in Europe and Canada, social indicators have sustained their significance better than in the U.S. Also recently, the correlations of democracy and economic freedom have been strongly advocated, which may be considered contentious. Due to political consideration there are major cultural differences between countries as well as dispute over the means to achieve welfare targets. It is also worth noting that at times international differences in data availability have influenced the selection of a correct method (Neumayer 2000).

The main message of the Commission on the Measurement of Economic Performance and Social Progress (2009), also known as the Stiglitz-Sen-Fitoussi Commission, was the inadequacy of current measurement practices[30]. Diener and Seligman (2004, 3) suggest that in the future developments of measuring national well-being, even if economists are also needed, psychology and behavioural sciences such as sociology, neuroscience and anthropology are likely to play important roles. However, the quantification of the cultural dimension is a struggle and notably it is also absent in the triple-bottom line of sustainability. This chapter has mainly discussed social indicators in the context of the social theories, measurement and politics relevant for developed

[29] The figure of 10.9 billion people in 2100 follows the medium-variant projection of the UN. The low-variant scenario predicts 6.8 billion people; whereas in the high-variant scenario the global population would reach 16.6 bn people in 2100. The main driving factor is the global fertility rate.

[30] The naming of the Commission stems from the three co-chairs, professors Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi. The Commission published an extensive report to seek relevant indicators of social progress and examine the limits of the GDP

countries. However, inversely also *ill-being* can, must and has been studied. Operating within a dynamics of global politics, I argue that ill-being globally can be better understood through a deconstruction of the concept of "development". Like social achievement, also human development needs to be understood in a historical context.

4.3 HDI and the new multi-dimensional measures of poverty and development

Also development economists have viewed utility in terms of socio-economic satisfaction of an individual's needs. Actually, researchers aiming to 'move beyond GDP' typically first come across the Human Development Index (HDI), which is embedded in the human development paradigm[31] (Nussbaum 2011; Nussbaum and Sen 1993; Sen 1999). Whereas researchers of SDIs attempt to take into consideration the ecological component and the future horizon, the motivation of development researchers has been to eradicate poverty. Nonetheless, both the SDIs and the HDI are motivated by a need to understand the world beyond a monetary view. To confuse things even more, some have attempted to make a distinction between 'human development' and 'sustainable human development' (Neumayer 2010), in which the latter aims to ensure that also future generations are able to meet their needs similar to present generations. However, both assume an anthropocentric perspective. Development and welfare economists have debated extensively the role of ends and means, but in the recent decades the study of ends has become more important than means (see also: Waage et al. 2010).

In the beginning, development economists typically followed means, using monetary-based poverty measures of income or consumption with measures as simple as the minimum income or the minimum calorie intake. In the early 20th century UK, Charles Booth had set a poverty threshold of a minimum amount of shillings that could support a family (Boyle 2010). More recently, or more precisely since 1990, the World Bank has used an international poverty line, or the "dollar-per-day" measure[32]. An absolute poverty line is a simple, although arbitrary economic figure. Typically, development researchers have set the poverty threshold through components such as food-energy intake or the cost of basic needs. However, as it is today known that not only physiological needs

[31] The human development approach has gradually replaced the earlier basic needs approach, a concept stemming from the ILO World Employment Conference in 1976. Where poverty may be understood and measured both in the contexts of *absolute* and *relative poverty*, the measurement of absolute poverty is built on the basic needs approach. Basic needs include the minimum resources necessary for long-term physical and non-physical well-being such as food, health and other social services; as well as participation and sufficient material means (consumption goods) in order to lead a meaningful life (Fukuda-Parr 2003, Streeten and Hicks 1979), following Maslow's hierarchy of needs (1943).

[32] A fixed nominal line based on currency will lose value over time, which means it needs to be adjusted. Later, the international poverty line has been corrected to USD1.25 per day. More recently, also the international line of USD2 per day has been used.

matter and that deprivation may also be social, recent understanding emphasises that food and non-food components should both be included (Ravallion 2008; Reddy and Pogge 2005). While fixed international poverty lines have been considered useful for the purpose of cross-country comparisons, they have been noted to correlate less with public conceptions of poverty within particular countries and regions (Graham 2005). Furthermore, some countries have deemed the use of a single standard as questionable, which is why many developing countries have also used their own national poverty lines (Ravallion 2008).

Earlier in the 1970s, new poverty measures had already been introduced: *poverty headcount ratio (H)* represents the number (or percentage) of people living below the poverty line (Sen 1976)[33]; *poverty gap (PG)* illustrates the depth of poverty, or how far the poor are from the poverty line; and *Sen's poverty index* (1976) attempted to view poverty multidimensionally as an index that calculates together the number of the poor, the extent of poverty and the distribution of income. These measures are still used and useful today: for instance, using 2010 data, the PG measure shows poverty in Sub-Saharan Africa to be much deeper than in the Asian region; and in the light recent decades, in Sub-Saharan Africa poverty seems to have been most intense in the early 1990s; and that recently the situation may have improved a little (WDI 2012).

Now, as has earlier been described, the level of material well-being measured through the GDP has been associated with development. But, such a powerful discourse of course also bears connotations with underdevelopment, and the linkage of growth with poverty eradication is a strong argument in development circles. This is interesting especially as a vast amount of evidence proves that in order to eradicate intra- or inter-country poverty, growth alone will not do enough. To name just one example, in Latin American countries recent regional economic development and integration to the global markets seems to have disproportionally benefited skilled labour compared to the poor (Graham 2005). Without actual economic transformation *and* improvements in social, political and human rights conditions, economic growth has little chances to lead into wider socio-economic development. Cross-country comparisons (see: Fukuda-Parr 2003) of the GDP against non-monetary measures are able to display the role of outliers, and how the aggregate wealth (in monetary terms) of certain states (including the likes of Angola, Botswana, Equatorial Guinea[34],

[33] However, Graham (2005) argues that cross-section studies that are conducted every few years may miss short-term movements in and out of poverty

[34] The warnings of the economists remain still true today because certain extreme cases like Equatorial Guinea place in economic rankings strangely well. Having found oil in the early 1990s that made the country experience a staggering average annual growth of 37.0 per cent between 1994 and 2003 (IMF 2012b), the GDP per capita of the country (USD

Gabon, South Africa or Swaziland) that typically should be able to provide quality social services in several countries actually translates poorly in the social dimension (See: e.g. HDR 2013a; WDI 2012).

For the past few decades, the HDI has played a significant part in epitomising the narrative of human development. As the HDI values three dimensions: health, education and income[35], it is a kind of a compromise of the productive capacity of an economy and certain factors that constitute social well-being. The most recent HDI statistics (HDR 2013a) rank 186 countries: Norway, Australia, the U.S., Netherlands and Germany stand at the top; while Burkina Faso, Chad, Mozambique, DR Congo and Niger occupy the bottom places. When the HDI was created, it initially found various critics, including the theoretically questionable approach of combining ends and means. But while at first the HDI was considered to lack political relevance, later its pragmatism has been appreciated (Waage et al. 2010; Stanton 2007; Sen 2000; Veenhoven 1996).

Nonetheless, the HDI is – all in all – a rather reductionist expression of the human development paradigm that expresses Sen's (1999, 1992) capabilities approach in which key capabilities in addition to being healthy, well nourished and educated also include other needs such as being able participate in the community life. Sen (ibid.) therefore distinguishes capabilities from functionings. Capabilities are attributes or skills that expand the range of things a person can be and do. Functionings provide and expand these opportunities in the real life (Robeyns 2011; Fukuda-Parr 2003). These functionings include both social and physical 'beings' (being well, undernourished, happy or depressed) and 'doings' as actions (consuming fuel, travelling or voting in an election). Therefore for Sen (1999), development is freedom because a person's capability can only become manifested in the realisation of the freedom of choice a person has over the alternative lives he or she can lead. But these choices are only possible through having ends and means that enable the realisation of human potential and create agency. However, as the HDI hides certain components of development based on ethnicity, gender or urban-rural disparities as well as human rights and the

27,478) is today higher than in Czech Republic, Portugal or the Republic of Korea. However, non-monetary indicators reveal that life expectancy remains amongst the lowest in the world (52 years), maternal mortality rate is high (240 per 100,000 live births), and over 75% of the population live below the national poverty line (WDI 2013; WHO et al. 2012). Export-based growth of oil (mostly) to Western countries has not been redistributed to the wider population.

[35] The HDI includes: one monetary indicator (income) and two non-monetary indicators (education and health), measured with three indicators (GDP, school enrolment and life expectancy). Together, these form an overall score. For details, see: HDR (2013b). The most recent update to the HDI methodology is from 2010. Since its introduction in 1990 by a Pakistani economist called Mahbub ul Haq, the HDI has become an integral part of the annual UNDP Human Development Reports (HDR). Haq (1995) has stated that the idea of the HDI was ''to shift the focus of development economics from national income accounting to people-centred policies" and for this reason the HDI combines both ends and means.

needs of marginalised groups like the disabled or indigenous people (and of course, the ecological component); in the recent years several alternative development measures have emerged (Ravallion 2010; Fukuda-Parr 2003) (*Table 1*).

Selected development indicators

	National poverty line	
USD 1/day	International poverty line / Dollar-per-day[36]	World Bank (1990)
H	Poverty headcount ratio	Sen (1976)
PG	Poverty gap	Sen (1976)
S	Poverty index	Sen (1976)
HDI	Human Development Index	Anand, Sen and ul Haq (1990)
HPI	Human Poverty Index	UNDP (1997-2008)
IHDI	Inequality adjusted Human Development Index	UNDP (2010)
GII	Gender Inequality Index	UNDP (2010)
GDI	Gender-related Development Index	UNDP (1995)
GEM	Gender Empowerment Measure	UNDP (1995)
GGI	Gender Gap Index	WEF (2006)
SIGI	Social Institutions and Gender Index	OECD (2009)
MPI	Multidimensional Poverty Index	UNDP (2010)
HHDI	Household-level Human Development Index	Harttgen and Klasen (2010)

Table 1: Selected indicators or indices measuring development or poverty (year of introduction)

To begin with, an adjustment of the HDI (or the GDP) with inequality can give more representative a figure about the well-being of general population in various countries. *IHDI, inequality-adjusted HDI* reveals that the global average loss in the HDI due to inequality is about 23 % (using data from HDR 2011, the global HDI drops from 0.682 to 0.525) to reveal that there is much more ill-being in the world than the HDI would make us think. In turn, *non-income HDI* removes the GDP from the HDI calculus, and highlights the role of education and life expectancy. Again, using HDR 2011 data, Cuba, Slovenia and Korea now move up the ranking; whereas Kuwait, Oman, Qatar and UAE drastically lose places compared to the HDI rankings. Then again, gender-corrected measures suggest that deprivation or ill-being may occur at least in part through the gender effect. *GII, the Gender Inequality Index* (UNDP 2010) reflects women's disadvantage in reproductive health, empowerment and the labour market to find Yemen, Chad, Niger, Afghanistan, DR Congo and Mali at the bottom of the chart[37]. Another suggestion, *GGI, the Gender Gap Index* (WEF 2012a, 2006) measures economic participation and opportunity, educational attainment, health and

[36] A fixed nominal line based on currency will lose value over time, which means it needs to be adjusted. After inflation-adjustment, the WB poverty rate was changed to USD 1.25 per day in 2008.

[37] GII was introduced in Human Development Report 2010, to replace Gender-related Development Index and Gender Empowerment Measure, introduced in HDR 1995. GDI was criticised for showing results too similar to HDI, understating the significance of gender disparities; whereas GEM was considered more relevant for developed than developed countries.

survival, and political empowerment using data from 135 countries to find Scandinavian countries at the top; and countries such as Yemen, Pakistan, Chad and Syria at the bottom. Finally, the 2012 rankings of *SIGI, Social Institutions and Gender Gap Index* (OECD 2012c) show similar types of results: Sudan, Afghanistan, Sierra Leone, Mali and Yemen lie at the bottom. In turn, out of other non-Western countries overall discrimination against women is lower in the Latin America and the Caribbean area than in certain more conservative countries[38]. When the gender view is taken, often times the Arab countries occupy the bottom positions.

However, considering Sen's capabilities approach, perhaps most authentically are the multidimensional assessments of poverty that have recently penetrated the development debate by describing the interlinked components that together constitute poverty: *MPI, Multidimensional Poverty Index* (or today: MPI 2.0) (Alkire and Santos 2010) reflects a household's capabilities in three areas with ten indicators: health (child mortality, nutrition), education (enrolment, years of schooling) and living standards (assets, floor, electricity, water, toilet and cooking fuel)[39]. Also, the recent *Household level human development index (HHDI)* (Harttgen and Klasen 2010) might be categorised in the same group with the MPI.

Already earlier, indices such as *Klasen's deprivation measure* (Klasen 1997, 2000; cited in Hulme and Mackay 2005) had focused on capabilities instead of means through a selection of components (while also aiming to avoid problems of aggregation, weighing as well as the assumption of perfect markets); the *core poverty study of Clark and Qizilbash* (2005) in South Africa had asked the communities themselves what factors constitute the core minimum dimensions of well-being; and Barrientos (2003) had constructed the *multidimensional measure of deprivation* in relation to a research that assessed the impacts of non-contributory pensions on older people in Brazil and South Africa. Since the days when poverty and development were understood only as income-based phenomenon, researchers have travelled a long way.

Indicators represent an idea of accountability and manifest a certain type of power in numbers. But actually also more broadly, in the development talk the logic of accountability has become one of the buzzwords. A similar logic of rankings in a political context is expressed in the Millennium

[38] SIGI as well as certain other development indicators omit the performance of developed countries due to perceived irrelevance

[39] For detailed notes, see UNDP Human Development Report 2013 – Technical Notes. Its earlier version, HPI, Human Poverty Index (UNDP 1997-2008) measured a short life, lack of basic education and lack of access to public and private resources.

Development Goals (MDGs) that since 2000 have aimed to frame international development policy[40]. In the set of eight international development goals, each goal has sub-targets and indicators for the purpose of monitoring and evaluation (Hulme 2009). Annually, the UN has published a MDG Report and a progress chart to evaluate how developing countries are meeting the targets[41]. The MDGs were a result of the UN Millennium Declaration that became combined with the technical work on standardised poverty measures by international institutions like the OECD, IMF, World Bank, UNDP and UN DESA (Waage et al. 2010).

The interesting part of these efforts in the field of international development is the considerable amount of criticism they have received. While the headline targets and figures of the MDGs have managed to grasp political attention; the goals have also been criticised for a choice of a certain set of figures and the omission of other critical dimensions, thus allegedly producing skewed views of development (Waage et al. 2010). Not only have aggregate headline figures seemingly downplayed intra-country disparities (like the HDI above), but also the measurement of productive sectors has been visibly absent from the entire MDG framework (Lopes 2013). Also, MDG 7 on 'environmental sustainability' has been framed from an anthropocentric perspective, and MDG 8 that encourages countries into creating 'a global partnership for development' has barely had a meaningful indicator to accompany it with. Also, the MDGs do not even address the issue of energy poverty. For such reasons, many have rather considered the MDGs a 'major distracting gimmick' (Antrobus 2003) in the way of tackling fundamental global power structures and dynamics associated with capitalism and inequality (Saith 2006) as well as targeting more effective policies than aid (Kenny and Sumner 2011; Easterly 2006), even if optimists have over the course of believed in the ability of the MDGs to deliver global poverty reduction (Sachs 2005), or at least some have seen that a MDG-type of framework could function, if it was modified and improved (Fukuda-Parr 2012; 2008).

Talking lengthy about the MDGs in the context of the measurement of sustainable development would seem trivial, if it was not for the fact that the MDGs have mainly looked at the world from the human development perspective without broader ecological considerations, even if conceptually, however, such an analysis has a visible loophole because using Sen's terminology,

[40] The UN Millennium Summit, considered the largest ever gathering of world leaders, was organised in September 2000 in New York. In March 2000, the UN Secretary-General had published the Millennium Report "We the Peoples"
[41] The MDGs 1-8 include the eradication of extreme poverty and hunger, universal primary education, gender equality and women empowerment, reduction of child mortality, improvement of maternal health, combating HIV/AIDS, malaria and other diseases, ensuring environmental sustainability and developing a global partnership for development.

"most functionings require some resources as inputs" (Robeyns 2011). What is more, as countries agreed to launch a process to develop a set of 'universally applicable' sustainable development goals or "SDGs" in the Rio+20 conference (UNCSD 2012; see also: Morrow 2012) and the MDGs are soon coming to an end, it suddenly seems that a new global measurement framework in which sustainable development is targeted more explicitly could emerge. If this framework would assume the general logic of the previous MDG framework of political goals and technocratic indicators, that jointly monitors countries and how they perform to reach these goals, a language that talks about the 'indicators of sustainable development' could assume a whole new meaning and make it coincidentally refer to a dashboard (see also: Moffatt 2008) of indicators.

These observations may be suggested to lead to the following conclusions. Looking at the history and relationship between development and social measurement and the recent surge of alternative indicators, we can notice that development researchers as well as international institutions have extensively developed their data collection and their measurement capacity for the use of policy advocacy. However, instead of looking at environmental bottom-lines, the motives of development research and poverty eradication have primarily been anthropocentric, for understandable reasons. Here does lie a certain type of paradox, though, for if developing countries were to leapfrog (Perkins 2003), that is, to develop while avoiding the ecological pitfalls of the modern industrial development, they would already need radically different policy options to the ones exploited by industrialised countries. For from the point of view of ecological sustainability, such development paths are ecologically burdening not least in terms of carbon emissions and material consumption, just look at China, a convincing example of a process of the externalities of rapid economic development.

Development advocacy of the recent past has mainly focused on health and education as is clearly manifested in the MDGs (Waage et al. 2010) as well as in the HDI, and more recently development indicators on economic liberalisation and democracy as well as security issues (Hulme 2009; Bandura 2008, 2005; Fukuda-Parr 2003) have gained ground. The understanding of these and dynamics is necessary so that we can understand how the marginalisation of ecological sustainability is manifested and how current narratives about development also hide other structural deficiencies of the international system including calls for fairer terms of trade, removal of agricultural or inefficient subsidies, tackling illicit capital flows or tax evasion[42] or addressing the

[42] An example of such a case is a G8 meeting in Northern Ireland in 2013, which agreed on certain initiatives on international tax evasion. However, the UK Prime Minister David Cameron failed to persuade fellow G8 leaders

imbalances of power. What is interesting, regardless, is at least the fact that also the development community is today increasingly aware of ecological constraints.

4.4 The quantification of the planetary boundaries

Ever since the 1980s environmental indicators have played an increasingly important role, following the success of social indicators. These days, environmental impact assessment signifies a detailed examination of local and global implications of the human impact, whereas still a few decades ago an assessment of ecological damage limited to the study of pollution (Sciubba 2013; Cobb and Rixford 1998). While the Stiglitz-Sen-Fitoussi report (2009) has called for clear indicators of our proximity to dangerous levels of environmental damage; no single indicator, however, is comprehensively able to monitor the human impacts on environment (Galli et al. 2012; Vermeulen and Koziell 2002). Therefore, indicator sets have often been used, and for instance in Europe, the European Environmental Agency (EEA) has employed a set of 37 indicators. In the quantification of the environmental dimension, three conceptualisations can help: *i)* the threshold hypothesis; *ii)* state indicators; and *iii)* pressure indicators. Thresholds are scientifically assessed tipping points in the ecosystems and natural cycles which, when they are crossed, may bear unpredictable consequences to the ecological system; state indicators express the state or condition of the environment; and pressure indicators examine the impact of human activities on the environment.

Certain environmental indicators: Air pollution, biodiversity (ecosystems, genetic and species diversity), desertification, direct material consumption, ecological footprint, energy consumption, fisheries, global material resource consumption, greenhouse gases (CO_2, N_2O, methane and other GHGs) or the carbon footprint, marine pollution, nitrogen surplus, organic farming, renewable energy % in electricity consumption, soil degradation, threatened species, sustainable land use, waste

The Global Environmental Outlook 5 (GEO-5), which informs governments and stakeholders about the state and trends of the global environment, has employed the DPSIR framework (drivers; pressures; state; impacts and responses). Published in 2012, the main message of GEO-5 is that if current environmental trends continue, several critical thresholds may be exceeded beyond which irreversible changes to the life-support functions of the planet may occur. In the most recent Global Biodiversity Outlook (GBO-3), 10 of 15 headline indicators show unfavourable trends for

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registers of public ownership to be made public and automatic exchange of tax information not extended to poor countries (The Guardian, June 18, 2013)

biodiversity, that is negative effects to the abundance, diversity and variation of different forms of life, plants, animals and ecosystems (WRI, IUCN, UNEP 1992)[43].

Rockström et al. (2009) provide one framing to ecological thresholds with their mapping of nine planetary boundaries in the areas of: climate change, ocean acidification, stratospheric ozone depletion, nitrogen cycle, phosphorous cycle, global freshwater use, change in land use, biodiversity loss, atmospheric aerosol loading and chemical pollution (See also: Annex I). The illustration of these boundaries attempts to establish evidence-based thresholds to analyse, package and summarise information in a meaningful way to instruct policy-makers and non-experts. Their findings suggest out of nine planetary boundaries, in three areas (biodiversity loss, climate change and nitrogen cycles) safe thresholds have already been passed (*Image 5*).

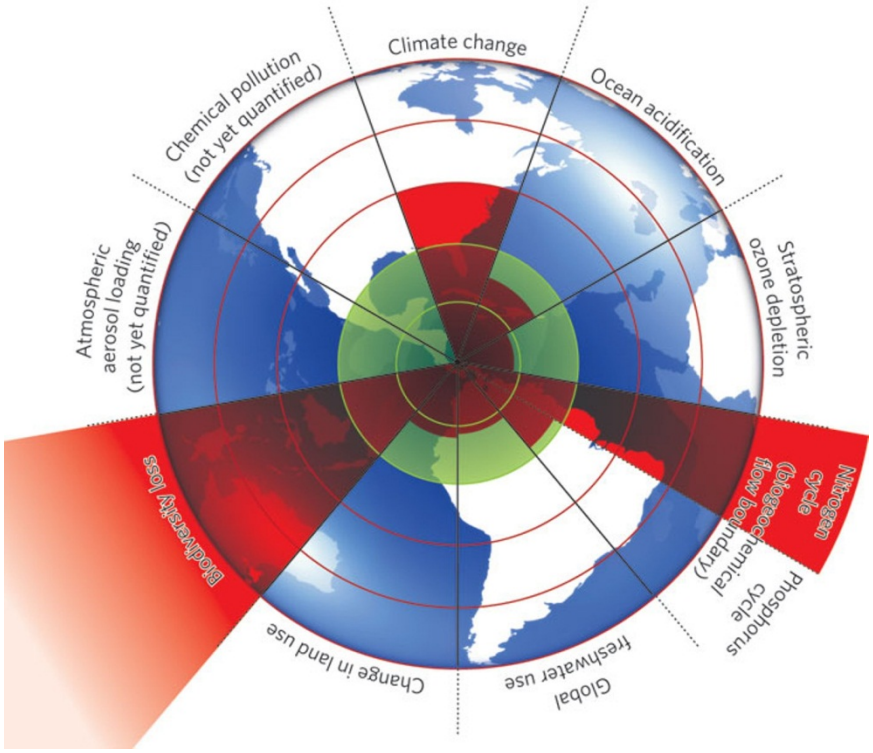

Image 5: Safe operating space for humanity: planetary boundaries (Source: Rockström et al. 2009)

In terms of biodiversity, it is known that species are becoming extinct at an increasing rate, even if this takes place geographically unevenly – and most of all in biodiversity hotspots (Pimm and

[43] According to the Convention on Biological Diversity (CBD), biodiversity is 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'. Elsewhere, the concept of biodiversity also been criticised for its all-encompassing nature prone to consider all biological entities from all biological levels from species to genes and bacteria (Faith 2008; Sarkar 2005)

Raven 2000)[44]. Unlikely a coincidence, in the U.S., there is a high correlation (R2 = 0.99) between the GDP and the number of threatened and endangered species listed under the Endangered Species Act (Czech et al. 2005; Czech et al. 2000). More alarming is the fact that the state of biodiversity is in decline because the pressures on biodiversity continue to increase, mainly due to habitat loss, even if conservation efforts have improved (ibid., 17). I claim that a possible explanation to the declining state of biodiversity concerns the management of information about biodiversity, as has earlier been argued by Stuart et al. (2010b), who see species and extinction rates as "the neglected disciplines of biology" (See also: Agnarsson and Kuntner 2007; Wheeler et al. 2004; Wilson 2003; Chichilinsky 1998)[45].

Vermeulen and Koziell (2002) have suggested that the lack of exchange and incoherence amongst different biodiversity assessments have hindered the strength of conservation efforts. Indeed, in the past biodiversity was outrightly deemed "too broad and vague a concept to be applied to real-world regulatory and management problems" (Noss 1990) and even today, the WWF (2012) states that given the complexity of global biodiversity, it is very difficult to provide a complete picture of its overall condition. In 1992, the Convention on Biological Diversity (CBD) sought to address this challenge and developed a range of indicators to provide assessments of trends in the state of biodiversity (genes, populations, species and ecosystems); the pressures being imposed upon it; and the responses adopted to address biodiversity loss. Yet, today there remain quite a few approaches.

Many at least are familiar with the IUCN Red List of threatened species, as it is known that certain species compete for space in some of the most densely populated regions on Earth. Also other studies are able to demonstrate this: for instance the living habitat of tiger has declined to 7% of its former extent and the populations of river dolphins have declined due to infrastructure development (WWF 2012; Sanderson et al. 2006). The challenge with the IUCN Red List is its omission of many plants, lower vertebrates or fungi, which is why some consider their conservation efforts are undermined (Stuart et al. 2010b). In response, Stuart et al. (2010b) have instead called for "a barometer of life" that would serve as a broader taxonomic base of threatened species assessments. They argue (ibid.) that this would improve conservation efforts, policy decisions as well as the national-level biodiversity indicators themselves.

[44] Two thirds of all species are found in tropical humid forests that cover only 2% of global (ice-free) land surface
[45] Biological taxonomies determine the extent of categorizations, but estimates suggest that the number of different species globally ranges between 4 to 12 million, of which only about 1.4 to 1.9 million species have been mapped (Agnarsson and Kuntner 2007; Bisby et al. 2012; Stuart et al. 2010a).

Such taxonomic approaches about the description and classification of biological species (see e.g. Wheeler et al. 2004) remind the eighteenth century effort of Carl Linneaus' of mapping and classifying animal species and plants, that later has expanded to also consider elements such as genes and ecosystems. Other recent mapping proposals include a call for "the barcode of life" where biological specimens from DNA are mapped and barcoded (Hebert and Gregory 2005); the use of corroborated phylogenetic patterns to quantify gains and losses in biodiversity (Dupré 1993, 107-120) as well as triage, referring to the sorting of species according to quality. Understandably, however, biologists have tended to reject such cost-benefit approaches. Rather than the humankind assigning values in a utilitarian spirit to different species they know little about (Faith 2008; Takacs 1996; Wilson 1992) biologists have considered it better to theoretically view all species as equal and irreplaceable for humanity. The downside of an aggregate figure of biodiversity is the fact that while using an aggregate figure is compelling; the management efforts are left to local entities (Vermeulen and Koziell 2002). Also, a global aggregate undermines the fact that ecosystem services have instrumental value locally rather than globally. Rather than advocating the use of a single biodiversity indicator, recently ecosystems-service based approaches (TEEB 2010) have gained ground that underscore the significance and economic benefits that ecological conservation has in local settings.

This is rather typical for a post-positivist attitude towards science that has accepted diversity in measurement approaches and acknowledges the value-ladenness of scientific concepts. In addition, researchers these days are also rather aware that any increase in scientific knowledge will only make any type of 'objectivity' less likely (Faith 2008; Norton 2001, 1994). However, from the policy perspective this is somewhat problematic. While a single objective scientific definition to the measurement of biodiversity may be impossible, digestable information is crucial for any policy action and the conventional wisdom will remain that more species are dying than humankind will ever know.

The second planetary boundary that has been "crossed" (Rockström et al. 2009), but perhaps the single biggest policy issue of the international community concerns climate change. Because there is a high level of political debate and even scepticism with regard to climate change, I will devote this issue more attention than to any other bottom-lines discussed in this paper. Such a choice can be justified based on the possible risks that are involved with climate change, which in the light of current scientific evidence are far beyond any previous concerns that the international community has attempted to tackle. Thus, I will now my attention turn to examine the rather considerable and

consistent evidence-basis about climate change. It has been known for a considerable time now that climate change is resulting from the increase of global atmospheric concentrations of greenhouse gases (CO_2, CH_4 and N_2O, fluorinated gases, together measured in the unit of CO_{2e})[46]. In the time of writing this paper, the level of global carbon dioxide was nearing 400ppm[47] (CDIAC 2013), having already passed the scientifically defined safe target for humanity of 350ppm that would likely have kept global warming under +1.5°C degrees (Hansen et al. 2008). The current trends suggest that also the politically agreed threshold of 450ppm that would restrain global warming under +2°C degrees will be attained soon enough (IPCC 2013, 2007; McKibben 2012; Dessler and Parson 2009). This implies a significant increase in the emissions levels from the pre-industrial era, when emission levels at maximum reached 280ppm (*Image 6* and *Image 7*, see: next page).

According to the IEA World Energy Outlook 2011, the door to keep carbon emissions in a level that would contain the average global warming under +2°C will 'close' by 2017 (IEA 2011b). Another way to put it is that the humankind will already be so 'locked-in' to polluting technologies and infrastructure that changing the course afterwards will not be possible. Other studies follow these estimates. Bill McKibben's (2012) article called "Global Warming's Terrifying New Math" that was published in July 2012 in the Rolling Stone magazine looked at the situation from the viewpoint of the total amount of emissions that *have* been released and *can* still be released. McKibben (ibid.) estimated the humankind to have a remaining carbon budget of around 565GtC to keep global warming under the *politically* agreed threshold. Recent studies support these estimates. The IPCC (2013) AR5 study estimates that between 1751 and 2011, an estimated amount of 531 gigatonnes [446; 616] of carbon (GtC) was emitted, and another study by Boden, Marland, and Andres (2010) notes that half of the emissions have occurred since the mid-1970s, which evidently communicates about the worrying direction of the emissions trends[48]. Globally, an average of +0.8°C increase has occurred compared to pre-industrial era, and in addition, the already released CO_2 alone is likely to warm the atmosphere another +0.8°C (World Bank 2012; McKibben 2012). Each of the last three decades (1980-1990, 1990-2000 and 2000-2010) has been successively warmer at the Earth's surface than any preceding decade since 1850, and in addition, the Arctic areas seem to be warming at a double pace compared to the global average (IPCC 2013). Also more broadly, the critical question with regard to climate change concerns the rate of change.

[46] Scientific awareness about global warming is rather mature, however. The first signs of the greenhouse effect were noted already in the 19th century by Joseph Fourier and John Tyndall, and quantified in 1896 by and Svante Arrhenius.
[47] Particles per million (ppm) refers to the level of concentrations of greenhouse gases in the atmosphere
[48] Research by Boden, Marland and Andres (2010) suggested that approximately an amount of around 337 gigatonnes (GtC) had been released between 1751 and 2005

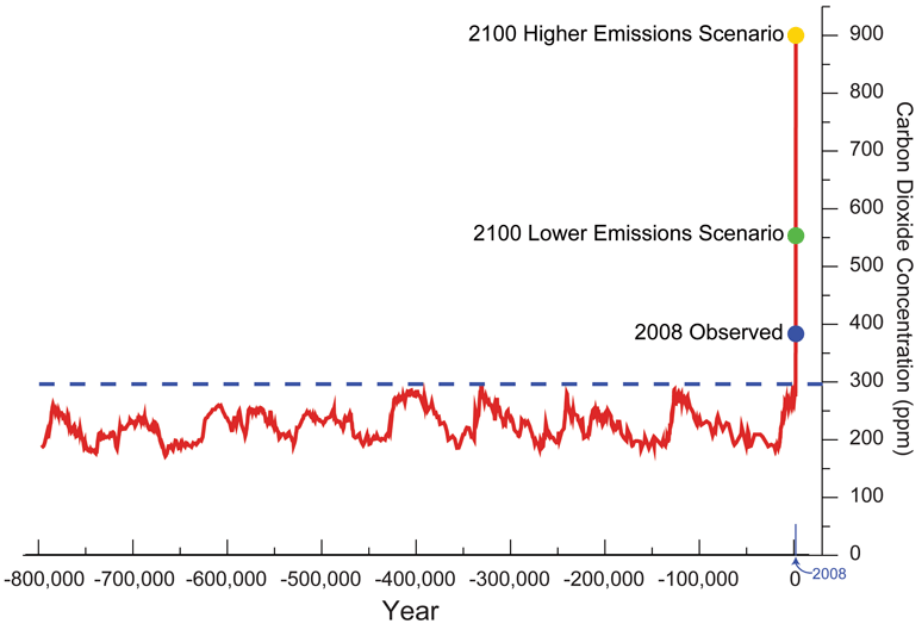

Image 6: Long-term data of CO_2 in the atmosphere in the past 800 000 years (Source: Karl et al. 2009, 13). CO_2 concentrations have been measured from trapped bubbles of air in the Antarctic ice core. Over this long period, natural factors caused the carbon levels to regularly fluctuate between 170ppm and 300ppm (parts per million). In 2013, the level of 400ppm (parts per million) is already reached. (Original data: Lüthi et al. 2008; Tans 2008). The green and the yellow point depict two emissions scenarios with higher and lower boundaries as projections to 2100, conducted by the International Institute of System Analysis (Source: IIASA 2008).

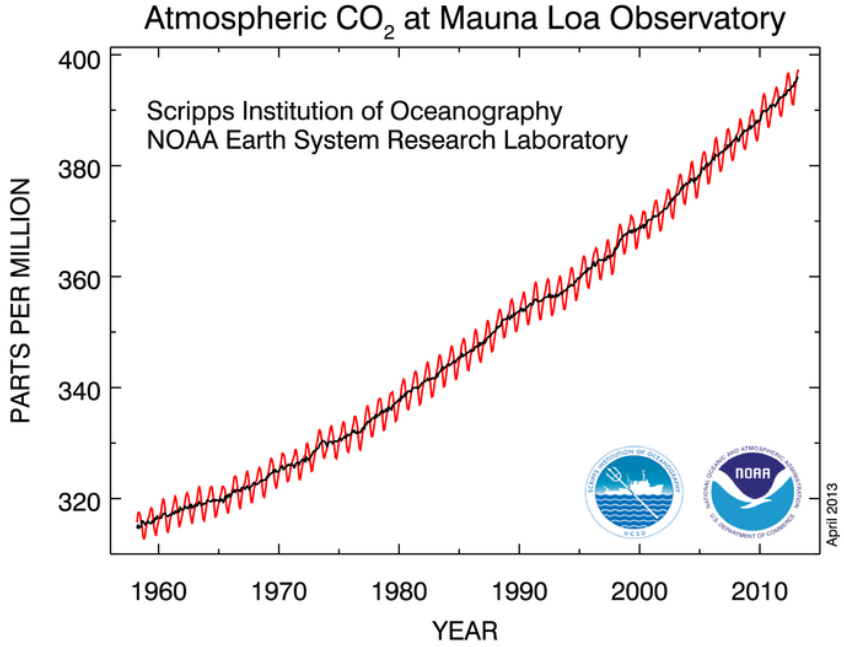

Image 7: Short-term data of CO_2 in the atmosphere from 1960 to 2013 (Graph from: April 2013). In the latter part of 20th Century, the increase of carbon concentrations was a steady and an accelerating trend. In between 2000 to 2010, the increase was 19ppm whereas between 1960 and 1970, the increase was 10ppm over a decade. In 2013, CO_2 levels reached 400ppm (parts per million) for the first time in history. (Source: Atmospheric CO2 at Mauna Loa Observatory, NOAA-Scripps 2013)

The International Energy Agency, which has published several scenario reports has published estimates of global warming trajectories, and found global warming averages to lie between [+3.4°C; +5.3°C] (IEA 2013) and [+3.5°C; 6°C] (IEA 2011b). What is worrying is the fact that the lower-bound estimate of over a +3°C warming even takes into account the establishment of new policies. These scenarios are also in line with and unfortunately above the worst-case scenario of the previous IPCC (2007) AR4 report, which six years ago projected a world average temperature increase between +2.4°C and +6.4°C. What is notable to find in these estimates is the fact how the projected *minimum* increase of global warming has been heightened. All in all, the recent reports on climate change over the past years all give a consistent message (Anderson and Bows 2008; IEA 2011a, 8; IPCC 2007; IPCC 2013; McKibben 2012, Smith et al. 2009): year after year, the current path trajectory is increasingly far from the initial hopes to limit climate change.

And is there a chance that science could be wrong? Unfortunately, this seems unlikely. In spite of the fact that climate sceptics believe otherwise, the impact of the human factor on climate change has been concluded with an increasing level of confidence in successive IPCC reports. The most recent IPCC (2013) report concludes anthropogenic, that is human-induced, climate changed to be very likely at a 95% confidence level. Other studies have estimated 97-98 % of climate scientists to have a consensus of global warming as a result of human action (Cook et al. 2013; IPCC 2013; Anderegg et al. 2010; Doran and Zimmermann 2009; Oreskes 2004)[49]. Quite simply, following the industrial revolution, the human activity and the current global economy that is locked in the use of fossil fuels (Urry 2011) are the main reasons for the increase in greenhouse gases, and bound to cause global warming in a long-term perspective (IPCC 2013, 2007).

I argue that it is not trivial *not* to understand the connections between these different factors, and because understanding these figures may seem somewhat difficult, or at least take a considerable amount of time, I have attempted to summarise them here as concisely as possible. These figures could be difficult to understand because greenhouse gas accounting was officially launched by the

[49] In 2013, Cook et al. reviewed 12 464 academic papers from 1991 to 2011, 97.1% endorsed that human beings are causing climate change. Among self-rated papers of 1 200 scientists as respondents, 97.2% shared the similar view. In 2004 in an earlier study, Naomi Oreskes had examined 928 peer-reviewed academic papers from 1993 to 2003 and found none of them rejecting human-caused climate change. Importantly, Cook et al. (2013) underscore a significant gap with the consensus and the public perception about the consensus. In the US, for instance, only 47-60% of the public believe that there is a consensus among scientists compared to the actual consensus. In 2010, Oreskes and Erik M. Conway authored a book "Merchants of Doubt", writing how in history repeatedly it has been possible for a handful of politically conservative scientists to play a disproportionate role in controversial debates to influence policy-makers and the general public. In this regard, Aronowitz (1988, 256) reminds of C.S. Peirce's views, in which Peirce defined "truth" as the proposition about which members of the "legitimate" scientific community agree

WRI and the WBCSD only in 2001 (See also: WRI et al. 2013). And even a likely careful attempt to establish a reliable inventory of measurements took four years of planning. Furthermore, because these figures and the logic behind them is relatively recent, I have found it worthy to explain also to the reader, in order to allow anyone to make an informed judgment of the current situation. Summa summarum, as has been demonstrated above, climate change and greenhouse gases can be quantified in various ways, but at least by viewing the amount of emitted carbon in the atmosphere (GtC); the level atmospheric greenhouse gas concentrations (ppm); the global warming potential of greenhouse gases (CO_{2e}) or the change in temperature degrees (°C). However, temperature makes a rather *poor* indicator because change in climate conditions is observed over a 30-year period based on averages, and annual temperatures can fluctuate yearly, even if the long-term trend would point upwards. Perhaps the most rationale way of forming the equation is to look at the amount of emitted carbon (GtC), compared it to the safe level of atmospheric greenhouse gas concentrations (ppm), based on the amount of warming (°C) that may take place. This equation seems to lead to a conclusion that leaves little room for second-guessing.

After an exhaustive discussion on climate change, it may seem almost irrelevant to focus on other environmental pressures. However, looking at climate change as an isolated phenomenon could lead to a too simplistic a view, detaching climate change from its root cause, that is, human pressure on the environment. Therefore, it is interesting also very shortly to note the third planetary boundary that has been assessed to be crossed, namely local to regional-scale human interference with the nitrogen cycle and phosphorus flows that has induced abrupt shifts in lakes and marine ecosystems (Rockström et al. 2009). The European Nitrogen Assessment can be taken as an example (Sutton et al. 2011a). Only in Europe, the overall environmental costs of all reactive nitrogen losses are estimated at an €70–€320 billion annually (using 2011 rates), thus outweighing the direct economic benefits (ibid.). Nitrogen has adverse impacts on water quality, air quality, the balance of greenhouse gases, ecosystems and biodiversity, and soil quality, with agriculture, transport and industry, wastewater treatment, and societal consumption patterns being the main sources of nitrogen (ibid.). New communication tools such as nitrogen footprints have already been suggested to reduce excess consumption of animal products (Sutton et al. 2011b; 2011a) because as it stands, 33% of the world's 'sustainable nitrogen budget' is used only to produce meat for EU citizens who themselves account only for 7% of the world's population (Raworth 2012a).

Having discussed ecological thresholds using the framework of Rockström et al. (2009), it is worthy to remark that also other major environmental assessments are in line about the human

pressure on environment and the level of unsustainbility. The Millennium Ecosystems Assessment (2005) concluded that 60% of world's major ecosystem goods and services have been degraded or used unsustainably, with 52% of world fisheries have been found fully exploited with no room for expansion, 19% overexploited, 8% depleted and only a single percent recovering from depletion (FAO 2009, 2005). Also between 1990 and 2010, the average annual deforestation rate was 13 million hectares mainly due to conversion of forests to agricultural land (FAO 2010), which consequently and unfortunately also accelerates climate change. There number of other areas to cover continues a long way statistics as well. The challenge with environmental change like land degradation or biodiversity loss is in how it may occur gradually over a period of time rather than instantly.

What is interesting to notice is the fact that many statistics considered as environmental data seem to have been created and evolved because of human needs to control the environment or perhaps only more recently, to improve the state of the environment. This has likely also affected policy-making and the framing of political approaches. Understanding this matters because many studies confirm that the failures to stop environmental degradation and biodiversity loss are considered to not only be a consequence of increased pressures, but also insufficient political responses (Collen and Baillie 2010; Gärdenfors 2010; Knight et al. 2010; Stuart et al. 2010a). Politically, international environmental goals remain fragmented in a weak international framework characterised by isolated governance efforts. UNEP (2012) estimates that out of the 90 of the most important environmental goals agreed by the international community, it is estimated that significant progress has only been made in four. Ecosystem thresholds might not be evident until they have been breached (see e.g. WRI 2011). While there have been increasing efforts to gather environmental statistics (NEF 2006), and new methodologies (footprint analysis, life cycle assessment, et cetera) have emerged, the lack of sufficient long-term data continues to hinder the monitoring of long-term environmental changes (Hardi and DeSouza-Huletey 2000).

GEO-5 suggests that not only should environmental data be linked with national statistics to place the environment at the heart of national priorities and policy making, also a redefinition of wealth beyond GDP to a more sustainable metric is necessary to improve the well-being of all communities. What could be said is that even if the understanding about the ecology, climate change and human pressures on environment all have drastically improved and to some extent helped conservation efforts, compared to the breadth of other type of statistics and their ability to

instruct policymakers, there is still a long way to go as perhaps illustrated by the following statement about the GDP:

"Much like a satellite in space can survey the weather across an entire continent so can the GDP give an overall picture of the state of the economy. It enables the President, Congress, and the Federal Reserve to judge whether the economy is contracting or expanding, whether the economy needs a boost or should be reined in a bit, and whether a severe recession or inflation threatens. Without measures of economic aggregates like GDP, policymakers would be adrift in a sea of unorganized data. The GDP and related data are like beacons that help policymakers steer the economy toward the key economic objectives."
(Samuelson and Nordhaus 1995)

As Samuelson and Nordhaus (1995), the GDP has strong institutional strength and is closely connected to the political system. Considering how changes in stock exchanges are followed by investors and individuals as an operational routine on a minute-to-minute basis, day after day, environmental evidence such as ice-core data are a result of lengthy research projects.

4.5 Happiness indicators and the meaning of life

One way to begin addressing the issue of ecological sustainability may be for researchers as well as communities to consider paying more attention on the psychological, rather than the material dimension of well-being alone. After all, it has been suggested that a focus on material well-being distracts from what is essential in human life. Previous studies have found laypeople to overestimate the impact of income on well-being and in the expense of other goals to erroneously engage in the increase and maintenance of their wealth (Aknin et al. 2009). Although much of the happiness work stems from the field of psychology, the socio-economic debate mainly follows the so-called Easterlin Paradox, following Richard A. Easterlin who in 1974 formulated a theorem suggesting that even if there is a growth in a country's GDP this might not necessarily increase the happiness of the population (Easterlin 2005, 2003, 1995, 1974, 1973). Indeed, similar levels of life satisfaction have been found between people on the Forbes' list of the richest Americans, Inuits in northern Greenland and East African Maasai (Diener and Seligman 2004). Like The Beatles who in the 1960s stated 'money can't buy me love'; academics have put it even more bluntly: "despite massive increases in purchasing power, people in the West are no happier than they were fifty years ago" (Layard 2006).

After Easterlin, others have come to similar conclusions. Zolatos (1981) suggested that after many basic features of economic and material well-being are satisfied, more goods for the sake of the

economy does not really increase the enjoyment of human life. A number of researchers (see e.g. Max-Neef 1995) have advocated in the favour of an economic threshold after which economic growth could actually lead to the deterioration of quality of life. Frey and Stutzer (2010) suggest that after around USD 10 000 "the average income level in a country has little effect on average subjective well-being" and Layard (2003) suggests the threshold to lie around USD 15 000. At least, above a certain threshold it seems that there are only marginal increases in well-being (Diener and Seligman 2004; Helliwell 2003; Schyns 2003).

Therefore, the attention of researchers has turned to psychological well-being (Diener and Seligman 2004; Seligman 2002), happiness and the study of flourishing, which stem from the field of positive psychology and the recent work of Martin Seligman as well as Abraham Maslow's thinking in the 1950s. Lyubomirsky et al. (2005) define happiness as frequent positive affect, high life satisfaction, and infrequent negative affect. Psychological well-being can be understood as a subjective component of overall well-being that social indicators have measured, using 'objective' measurement techniques. Happiness is actually operationalised in a fairly simple manner. Typically, the quantification of happiness is conducted by equating it with life satisfaction or *subjective well-being (SWB)*. An individual can simply be asked: "Taking all things together, how happy are you?" The possible answers then range from 0 (extremely unhappy) to 10 (extremely happy).

"All things considered, how satisfied are you with your life as a whole nowadays?" (European Social Survey);
"How happy were you yesterday?" (UK Office of National Statistics);
"Taking all things together, would you say you are: very happy, rather happy, not very happy or not at all happy?" (World Values Survey)

Table 2: Questions in different studies measuring happiness

Earlier, neoclassical economists had avoided survey data, fearing that respondents' bias of moods at the time of the survey, or minor changes in the phrasing of the survey questions could produce data skewness (Stanton 2007; Graham 2005). However, recent studies suggest that happiness surveys are methodologically a fairly reliable measure because they seem to correlate with other well-being measures and social and material conditions (Abdallah et al. 2009). Following such techniques, in 2012 the UN published the first World Happiness Report. Whereas the WHR 2012 ranked 50 countries, in 2013 the list of countries had been extended to 156 countries. According to the latest WHR (2013) report, the happiest countries consist of welfares states such as Denmark, Norway, Switzerland, Netherlands, Sweden, Canada and Finland. Also in 2013, the OECD published

guidelines how to measure subjective well-being and use it for policy-making for industrialised countries.

Actually, some Western countries have already begun the measurement of happiness. France started the publication of a happiness indicator in 2009, and the United Kingdom followed in 2011. While not long ago, unhappiness was a typical state of mind in a society demanding obedience from its citizens in an earthly struggle where happiness was reserved for the after-life (Hagerty and Veenhoven 2003), in Western countries this seems to have somewhat turned upside down: life satisfaction and intrinsic motivation have actually become important components of professional life. Rather than a struggle, postmodern values encourage people's ambitions for fulfilment. Interestingly, though, in the Eastern philosophy, this has perhaps been known all the time – and even measured, or so is at least the case in the country of Bhutan, which has measured national happiness with its Gross National Happiness (GNH) indicator since the 1970s. However, let us now assess the happiness debate, as we have conventionally known it and discuss the GNH more carefully later in this paper.

Selected happiness indicators

SWB	Subjective well-being	Veenhoven (1996)[50]
HLY	Happy Life Years	Veenhoven (1996)
GNH	Gross National Happiness	Bhutan (1972)

Table 2: Different approaches related to the study of psychological well-being

Subjective well-being (or life satisfaction) constitutes of multiple factors such as demographic status, personality traits and attitudes as well as goal characteristics (See also: Lyobomirsky et al. 2005, Easterlin 2003), and could be undermined by factors such as downward social mobility, illness, insecurity and unemployment (Graham 2005). Veenhoven (2004, 1996) has also suggested an extension to the SWB measure, an index called *Happy Life Years (HLY)*[51], which multiplies SWB with life expectancy in order to combine a subjective and objective elements to wellbeing. This would suggest that looking at income alone is an insufficient explanation to happiness. While this evidently makes sense, the Easterlin paradox that attempts to find a point beyond which looking at income makes sense at *all* has attracted criticism. Those critical of the paradox note that various

[50] Ruut Veenhoven, a Dutch sociologist, has hosted a World Database of Happiness with data extending to the year 1958, and has worked extensively on the issue of the measurement of happiness based on experienced life satisfaction.
[51] And what is more, there is also an extension from the subjective well-being (SWB) theory with an environmental component known as the Happy Planet Index (HPI). Originally in her 1996 article, Veenhoven called the measure Happy life-expectancy (HLE)

studies affirm high correlations between the GDP and life satisfaction, typically reaching from 0.50 to 0.70 (Moffatt 2008; Diener and Biswas-Diener 2002) and even higher correlations have been found (see e.g. Stevenson and Wolfers 2013). Hagerty and Veenhoven (2003, 22-23) explain that a strong correlation between life satisfaction and GDP per capita income levels is consistent with the needs theory and contrary to strong relative utility models. The needs theory suggests that because citizens have unmet needs, they may be gratified with goods and services, even if this happens with a diminishing marginal utility of income (ibid.).

Studies by Stevenson and Wolfers (2013, 2008) suggest that there is a *direct* well-being-income linkage. A study they published in 2008 examines three relationships: the contrast of (income) rich and (income) poor members of a society; the contrast of rich and poor countries; and the paths of average happiness when the average incomes of different countries change. They observed that not only does happiness (or life satisfaction) seem to increase with increased income levels; but when economic growth is rapid also happiness increases rapidly. Another, more recent study of theirs (Stevenson and Wolfers 2013) suggests that there is no evidence of a satiation point in which well-being would cease to increase when income levels rise[52]. What is more, they suggest the linkage to apply universally because they find a relationship between the rich and the poor to be similar in both rich and poor countries. A more careful assessment, though, might suggest that rising income levels have rather been linked with broader socioeconomic development with "emancipative cultural change" that can increase personal freedoms and democratisation that develop together (Welzel et al. 2003) as well as a number of related individual factors such as employment, health, political freedom, quality of government or women's emancipation (Graham 2005; Hagerty and Veenhoven 2003). Suddenly, it seems as if those debating whether Easterlin was right or wrong seem to be missing the point.

Graham's (2009) dilemma she calls as "the happy peasant and miserable millionaire problem" perhaps best illustrates the issue. Graham (ibid.) suggests that when life satisfaction is measured, people from vastly unequal backgrounds, the income-rich of the industrial world and the income-poor of the developing countries may achieve equal scores in a uniform scale. The first finding here is the fact that when we are concerned about happiness, a person who is income-poor might not actually be living a miserable life, as we have thought. However, a more nuanced answer would

[52] Stevenson and Wolfers (2013) use data across 155 countries testing GDP per capita with World Bank data on World Development Indicators and life satisfaction with Gallup World Poll data between 2008 and 2012. In addition, they cross-check their findings with life satisfaction data from World Values Survey, Pew Global Attitudes Survey and the four-point happiness question asked in the International Social Survey Program

consider the need to look at the capabilities, functionings and the need of freedom that Sen (1999) writes about. And here, happiness makes a rather narrow framing of life and certainly does not assess the multiple ways of how the poor are often excluded of opportunities. Two very different groups can score equal points in a single measurement scale because poor people can be satisfied more easily because their expectations are lower, whereas company executives can be miserable for a number of other reasons (Graham 2009, 2005). Finally, it would be unfair to judge an income-poor person being better off than the income-rich person because income is often a means for certain types of opportunities. But, the question of opportunities can also be turned the other way around. If one is addressing this issue from the sustainability viewpoint, it might be again better to look beyond income and ask 'how much is enough'. For, if relative income is given importance, this might stimulate an ever-rising bar of perceived needs (Graham 2005).

What does this imply for policy? Well, it seems that although there is a good argument for the significance of material well-being up to a point, it is likely that beyond a certain point, strategies that *continue* to merely look at material well-being ignore other components that also have an impact on well-being. From the individual's perspective, education, health and leisure time with friends and family are important – the social capital Putnam (2001) writes about. This also suggests that to achieve such things, redistributive tax policies make a difference. A strategy of wealth accumulation may be doubted, at least if these increases are not re-invested to benefit larger groups. Hagerty and Veenhoven (2003) list public expenditure that may matter more than other alternatives in the efforts to increase happiness. Their suggestions include creating parks, roads or hospitals as well as improving social security.

In 1725, Francis Hutcheson who has been labelled as the forefather of the philosophy of the measurement of happiness wrote about "the greatest happiness for the greatest number" in his book 'Inquiry Concerning Moral Good and Evil' (see: Leidhold 1726) and ever since, a long intellectual trajectory runs from the spirit of utilitarianism and the Enlightenment to the ideologies shaping contemporary public policy. Over time, the field of investigation developed and narrower, quantitative definitions of individual welfare, or utility, have become the norm (Graham 2005). Even if happiness indicators have insofar had rather limited influence to public policy, recent interest suggests that this situation might be changing, and at least any theory explaining happiness should not use income as the *only* factor to instruct public policy (Hagerty and Veenhoven 2003). And, also various studies suggest that happiness is a worthy goal in itself. It was only in 2000, when Ed Diener first called for national accounts of well-being in his paper, later Lyubomirsky et al.

(2005) cautiously suggested that "enhancing peoples' happiness levels could be a worthy scientific goal, especially after basic physical and security needs are met", and now, happiness reports are already here. If this postulate is taken seriously, this would suggest that for nation-states it may make less sense to measure increases in economic productivity and how much they have in their pocket, and instead focus their efforts in the maximisation of the happiness of their citizens (Layard 2002). By the least, measuring subjective well-being can complement other social indicators that have earlier been neglected to focus on what people themselves actually think about how they are and about the world that surrounds them.

4.6 Analysis: Science has its own theoretical assumptions

Some already suggest that the world is living a new geological age shaped by the human impact, or the Anthropocene (Zalasiewicz et al. 2010, 2008; Crutzen 2002; see also: Leach 2012), so drastic are the impacts of human well-being to the ecology. It seems, though, that a number of challenges remain in science itself in providing a knowledge foundation that is suitable for the needs of sustainable development. It ought to be remembered that the international discussion on governing the commons caught both social science and political institutions off guard. Environmental writings and politics saw daylight in the 1960s and 1970s, whereas the creation of Bretton Woods institutions and the United Nations for international problems had coincided with post-World War II. The modern history of international relations and development studies are much more closely linked with the latter events rather than the ecological constraints[53]. Also political economy that has helped states govern, and economics that has taught about innovations, competitiveness and productivity have both ended up treating the commons as objects from an anthropocentric perspective, as resources *for* economic development. Weber's theory of instrumental rationality emphasised science and technology as vital components of the productive and administrative apparatuses of capitalism (Aronowitz 1988). Now, even if money and economic calculus in a pragmatic sense do run through the human history, the birth of national accounting is intimately connected to the rise of the nation-states (Hacking 1990) and the emergence of the GDP with the needs of a society of the 1930s.

Economic theories have also shaped the efforts of development scholars. While Wolfers (2009) makes a point in observing a very strong correlation ($p = 0.95$) between the HDI and the GDP to prove that economic development is essential for human development; the global considerations of

[53] Kjaer (2004) identifies four main schools of international relations: neo-realism (Keohane and Nye 2000), pluralism (Bull 1977, Jackson 2000), liberalism or solidarism (Rosenau 1995), and global democracy (Archibugi 1998, Held and McGrew 2002, Scholte 2011)

equity and justice (Harris 2010; Nagel 2005; Parekh 2008; Sen 1999; Singer 2004; Walzer 2011) have been undermined by theories that have treated capital flows "as something that has no agency" (Haufler 2009). At times, development has become reduced into an artificial North-South dichotomy (Ivanova 2007; Williams 2005), recreated and reproduced by academics who study it, undermining the calls of developing countries of 'a right to develop' (Gandhi 1972) and burdening the sustainable development debate.

Remembering economy ultimately as a social construct, an expression of human actions and between human beings, also the statistical measures of the economic discipline are remarkably advanced. "Unlike, say, deconstructionist literary theorists, finance professors [have] had an enormous impact on the business world" (Krugman 2009). In the latter part of the 20th century, the theories of economists built ground to the theories of finance, and the recent financialisation of the global economy seems now to have changed the nature of the economy itself (Fox 2009). In addition, also economic measures are deeply embedded in the day-to-day operations of human actions (Latour 1987). These days the digital codification of economic signals only further binds our understanding into it. The societal significance of economics needs to be contextualised in a context where it shapes our *understanding* about the world, how it is perceived and what choices we see available.

Callon and Latour (1992), in one of their essays question the Kantian "Great Divide" between nature and society. In a long-term historical perspective, Aronowitz (1988) describes the story of science as the conquest by "man" of nature to which philosophy became a servant. For long, the context of rationality remained unquestioned and science and technology were considered neutral instruments – after all the philosophers of Enlightenment worried about the harmful effects of pluralism in their valuation efforts (ibid.). From the perspective of recent history, only in the 1960s and early 1970s the ideas about social ecology and radical feminism emerged to resist the scientific worldview (ibid.). Within social science, contributions of global environmental governance, global environmental law and green political theory are fairly recent as well as of ethics and political philosophy that have re-gained ground to counter the reductionism of neoclassical economics (Sen 2000). However, we are perhaps in a situation where some sciences hold a more conservative position than others, and statistics may only be one of them. Somehow, it would be odd to disregard the role of the GDP and how it acts as the centre of local and national economies in a certain way symbolising today's global connectedness that has, first and foremost, been driven by the free-market economy. All this time, social scientists have struggled to liaise with natural sciences (see:

Raworth 2012c; Reid et al. 2010; Hacking 1999; Morgan and Morrison 1999), and in turn ecologists have traditionally had limited linkages with the political sphere. However, understanding ecological thresholds would be important, because contingent events may surprise the decision-makers and the public if they lack the instruments from seeing them coming (Hukkinen 2008).

We are now in a situation where scientists should carefully think when presenting information to users and how they can understand 'at a glance' how the quality of life (Hicks 2011) and the state of environment in a nation are changing. After all, science is near to being "*the* [sic] source of cognitive authority" (Haas 1992, 11). The construction of different measurement techniques in the context of a utilitarian spirit we have studied may also be called ethical accounting (Sen 2000). This is a rather new situation, for as noted by Porter (1992), for until the late 1970s accountants were largely autonomous and technical in their profession. Only critical studies began to contextualise their work into the social history of objectivity (ibid., see also: Aronowitz 1988). However, a narrow definition of utilities has been missing integration with the complexities the ecological dimension. Where Hacking (1990) illustrates how scientists tamed chance through the invention of probabilities, the same could and perhaps should in future happen to environmental data for the purposes of environmental management. Let us contextualise the situation in a historical perspective and consider the task economists were faced with in the 1930s:

> "The economic changes that occurred in this country during recent years are sufficiently striking to be apparent to any observer without the assistance of statistical measurement. *(...)* But attempts at an all-inclusive statistical picture can be made. National income measurements represent an attempt to describe the total activity of the national economy under one aspect, *viz.*, the size of the final net product."
>
> (Simon Kuznets, 1934, 1)

What Simon Kuznets wrote almost a hundred years ago may hold true to ecology today. Regardless of time and place, the human being is an entity whose well-being constitutes of psychological, physiological and social factors *and* the environment (s)he is dependent on. Recent happiness studies bring about a fresh viewpoint in particular when they emphasise the fact that the GDP is a worthy policy goal but not beyond a point where the ethical standards are sacrificed, the weak lose their dignity or place in the economy, community cohesion is destroyed or the environment or the climate, are put at risk (WHR 2012). In contrast, the HDI as well as most other socio-economic measures of development or poverty, adhere to the intellectual foundation of human development and economic development. Although such models provide good systemic insight, they take no

stand whatsoever towards the externalities of human action. Amongst the most important distinctions in the SDI thinking is the acknowledgment of ecological thresholds and leaning towards theoretical principles of natural science or ecological economics. At times, though, academics, have struggled in this task of producing coherent results based on political demand. In the University of East Anglia, climate scientists got challenged in an unfortunate episode labelled as the "Climategate", unable to provide a coherent communication to a sceptical media.

Perhaps the most interesting question lies in the consideration of choices that may need to be made between diversity and reductionism. It is interesting how in development circles the recent understanding of development (or poverty) as a multi-dimensional phenomenon (Nussbaum 2011; Sen 1999; Sen and Nussbaum 1993) exemplifies a move to escape the pitfalls of reductionism. Also, noting the other recent advances in the fields of development, ecological and happiness economics, it now seems as if economics would also be making a paradigmatic shift from reductionism towards heterodoxy (Colander 2000). However, it is questionable whether this heterodoxy can introduce models that become commonly accepted. At least in terms of indicators, the tendency to add more and more variables and components as new issues emerge (Thais 1989; cited in Booysen 2002) threatens simplicity of communication.

This chapter has argued that changes in scientific measurement theory have followed societal development (H_2), and this should carefully be taken into consideration when science is portrayed as a stakeholder in evidence-based policy making that also provides baselines for indicator construction. The question is about the relation and strength of the models and the reality (Morgan and Morrison 1999). One may try and imagine what kind of social science would triumph at the moment, had philosophers in Ancient Greece been less keen in their investigations on the purpose of life, or utilitarianists such as Bentham with their ideas of maximising good for the greatest amount not laid the essentially anthropocentric intellectual foundation upon which many of our today's ideas are based on. Even though the future development paths of science cannot be predicted, it seems that the progress of science most likely if not determines, but strongly shapes the theoretical opportunities to design indicators and consequently also frames public policy-making. At least it is easy to find the scientific discourse of today as very different from what it was two hundred years ago in many fields and yet still, so many of those classical principles still continue to influence our norms and conventions of thinking.

However, in real life, science is only one stakeholder amongst many (Nisbet and Mooney 2007). In between and next to science, there are multiple institutions that influence how and which kind of information is presented to the public. In this sphere determined by practical rather than scientific judgment, there is room for scientific and quasi-scientific evidence as well as 'misinformation' and 'noise' that all are likely shape the worldviews of the indicator end users. "(I)n science, programmatic success is judged by scientists alone; in society, programmatic success is judged not only by social scientists but also by citizens" (Schmidt 2008, 308). Therefore, the next chapter will turn to the indicators of sustainable development and assess how institutions shape our perceptions.

5. The institutional explanation to sustainable development

This chapter assesses the claim, according to which institutional background (H_3) affects the formulation and framing of SDIs. The indicators below (*Table 3*) form the empirical material of the study, and have been classified according to their current affiliation, which may also be suggested to indicate their level of institutionalisation into the political system.

Category 1: Academic institutions and research institutes		
SHDI	Sustainability-adjusted HDI	Pineda (2012)
SHDI	Sustainability-adjusted HDI (modified)	Huang and Quibria (2013)
HSI	Human Security Index	Hastings (2008-2011)
Sen Trend	Sen's trend of sustainability	Distaso (2007)
EPI Trend	Trend Environmental Performance Index	Yale (2012)
EPI	Environmental Performance Index	Yale (2006-)
ESI	Environmental Sustainability Index	Yale (1999-2005)
eSNI	Environmentally Sustainable National Income	Tinbergen and Hueting (1991)
SNBI	Sustainable Net Benefit Index	Lawn and Sanders (1999)
Category 2: Non-governmental organisations and think tanks		
WI	Wellbeing Index	Prescott-Allen (2001)
GPI	Genuine Progress Indicator	Redefining Progress (1994)
ISEW	Index of Sustainable Economic Welfare	Daly and Cobb (1989-)
CCPI	Climate Change Performance Indicator	CAN and Germanwatch (2005)
CF	Carbon Footprint	Wackernagel and Rees (1996)
EF	Ecological Footprint	Wackernagel and Rees (1996)
WF	Water Footprint	Hoekstra (2003)
HPI	Happy Planet Index	NEF (2006)
Category 3: Intergovernmental institutions / Multilateral institutions		
UN CSD set	UN CSD Set of Indicators	UN CSD (1996)
EU SDI	EU Sustainable Development Indicators	Eurostat (2005)
GS (ANS)	Genuine Savings (Adjusted Net Savings)	World Bank (1993)
UN SEEA	UN Environmental-Economic Accounting	UNSD (2012)
BLI	Better Life Index	OECD (2012)
Category 4: State		
	National SD indicators sets	UK, Germany, Finland etc.
REPI	Resource-efficient Performance Index	China (2006)
GNH	Gross National Happiness	Bhutan (1972)
	Thai Sustainable Development Index	Thailand
	Korean Sustainable Development Index	Korea
	Thai Gross Domestic Happiness	Thailand
	Malaysian Quality of Life	Malaysia

Table 3: List of the indices of sustainable development (SDIs) (name, author and year of creation)

Data have been sought from the UN Sustainable Development Knowledge Platform, the UN Earthwatch database, The Global Directory of Indicator Initiatives hosted by IISD which alone lists 895 indicator SD related submissions, the EU Beyond GDP project (2007-2011) listings, the EC-

JRC (2012) work on composite indicators as well as certain presentations by intergovernmental organisations as well as from the previous academic studies on SDIs that provide indicator listings (e.g. Galli et al. 2012; Mayer 2008; Moffatt 2008; Gennari 2007; Booysen 2002). To begin with, due to the vast number of SDI suggestions over the years, it would be impossible to make an exhaustive list of *all* possible indicators. As a first criteria, the indicators that are discussed are chosen based on their relevance to the SDI debate, employment by internationally recognised institutions and international visibility. Secondly, only indicators that have a relationship to the ecological dimension are included, which means that a single indicator may or may not include economic, social or other components – these dimensions have already been covered earlier in this paper[54].

Erkkilä and Piironen (2009) call for a critical stance to make the underlying normative assumptions of the indicators explicit. Partially, I have attempted to achieve this in the previous chapter. Here, I will continue this assessment through a scrutiny of the institutions in relation to their SDIs. In order to achieve a systematic review, Erkkilä and Piironen (2009, 136) propose three techniques of analysis: *i)* to study the organisation as a knowledge producer and how they define the concepts they attempt to measure; *ii)* to examine the attributes and indicators that are employed; and to study *iii)* the actors, their connections, interests, and intentions. I will loosely follow their advice, although going into details with each and every indicator in all the three dimensions would be out of the scope of this study.

My analysis begins with indicators that have recently been suggested in the academia, then examines how certain think tanks and non-governmental organisations have adopted or created SDIs of their own. After this, the role of intergovernmental institutions is studied, and finally, the state is put under scrutiny. This logic also follows the institutionalisation process of most indicators where researchers first put forward new proposals based on new scientific evidence and only later they become adopted by other stakeholders. Let it be kept in mind that such a diffusion process also happened for the economists who first developed the GDP and later saw it spread across countries around the globe, even if admittedly, their efforts also seem to have enjoyed of institutional support.

[54] To give a curious recent example, *Legatum Prosperity Index* (Legatum Institute 2013) claims to measure "prosperity" using eight dimensions and a staggering number of 89 indicators. However, *all* of the 89 indicators are anthropocentric: only three issues (water quality, sanitation, and satisfaction with environmental beauty) are related to environmental health and see ecology to have instrumental value. For this reason, also the *Quality-of-Life index* by The Economist Intelligence Unit does not make our comparison. Out of more historical indicators such as the HDI, the Human Development Index (ul Haq 1990) is discussed earlier in this paper; *MEW, the Measure of Economic Welfare* (Nordhaus and Tobin 1972) will not be discussed, and *LLI, the Level of Living Index* (Drewnowski and Scott 1966) will only shortly be mentioned in the overview next page

5.1 SDIs in the drawing tables of researchers

Over the last decades, there have been several propositions in the academia for an environment corrected-HDI (see e.g. Jha 2009; Dewan 2009; Constantini 2005; Morse 2003; De La Vega and Urrutia 2001; Ramanathan 1999; Dahme et al. 1998). A recent example is *SHDI, sustainability-adjusted HDI* (Huang and Quibria 2013; Pineda 2012), a composite indicator where the environmental component is integrated into the HDI in a way where SHDI penalises for the over-exploitation of the environment. Like in the HDI, the final score is a composite average of the measured dimensions. The results of the SHDI-HDI comparison find especially countries such as the U.S, China and Russia losing positions (Pineda 2012). Pineda (ibid.) states that his SHDI has been motivated by the "environmental challenge scenario" in a study of Hughes et al. (2012), which suggests that by 2050 the global HDI could drop by 8% (or even 12% in South Asia and in Sub-Saharan Africa) because of future environmental decline. A follow-up paper by Huang and Quibria (2013) suggests *a modified SHDI* on the basis of Pineda's work with three indicators: CO_2 emissions per capita, natural resource depletion and the share of permanent cropland.

Some researchers who have recently been affiliated with SDIs such as Pineda, Huang and Quibria seem to have worked within United Nations University and its independent research institute UNU-WIDER. While UNU-WIDER was created in 1984 in Helsinki, earlier the intellectual leadership was spurred mainly by the work of the United Nations Research Institute for Social Development (UNRISD) that had focused on building social indicators of development into econometrical development models (Prasad 2004). Founded in the 1960s, the UNRISD helped the development of *Level of Living Index, LLI* (Drewnowski & Scott 1966), and the social indicators boom of the 1970s further inspired international agencies to develop indicators as a part of their mission (Cobb and Rixford 1998). However, after promoting holistic and multidisciplinary approaches to social development in the 1980s, in the 1990s UNRISD lost intellectual leadership to the OECD, World Bank – and the UN itself (Prasad 2004). Still a relatively small research institute[55], UNRISD now explores social policies for inclusive and sustainable development (See: UNRISD: Research Agenda).

It might be fair to state that in general, development scholars seem to be aligning towards considerations of "sustainability". To give an example, the *Human Security Index, HSI* adheres to the rather recent notion of human security and defines development as a "package of good

[55] In 2011, the total expenditure of UNRISD was USD 3,912,952.

governance deliveries including peacefulness, fair circumstances to all people, and long-term sustainability" (Hastings 2008). Considering national security as the bottom-line, the HSI is a composite indicator that combines economic, environmental and social *fabrics* using over thirty sub-indicators. However, Hastings mentions, that his project is not aimed for long-term purposes.

Also Amartya Sen's increasingly popular capabilities approach seems to inspire academics to connect development theory and environmental analysis. For example Distaso (2007) has attempted to create a multidimensional index of sustainability for EU countries. Variables in what he calls "*Sen's trend of sustainability*" include consumption, income distribution, life expectancy, health, education, employment, pollution and aesthetic and cultural values through the percentage of protected areas. In his ranking of 15 EU countries, Sweden, Austria, France and Germany make the top four. In spite of Distaso's aim to follow Sen's capabilities approach, Distaso's index can be criticised for an arbitrary selection of ecological issues and the exclusion of issues such as biodiversity or climate change. And, although Distaso claims to have employed the concept of homo politicus, an ethical individual (Faber et al. 2002; see also: Jager et al. 2000; Gintis 2000), the worldview of Distaso's index is fairly anthropocentric: it mainly measures human well-being in a quality human environment. Therefore, it seems that other proposals using Sen's capabilities approach would be welcome.

The weakness of the proposals of Hastings (2008) and Distaso (2007) as well as many other SHDI-typed composite indicators is that they seem to suggest that the ecological view can be adopted by only adding an additional ecological component to existing anthropocentric measurement frameworks. For instance, knowing that the HDI has three dimensions, attaching environment as the fourth dimension will not change a ranking much; it merely makes environment one fourth of the overall score. Consequently, an individual country interpreting the score would likely not see a great need to change its current consumption patterns. In short, it may be said that an index *does not* yet measure sustainability, if it simply includes ecological, social and economic components. Such judgment rather reflects uncritical research choices that may lead to false judgment and allow limited space to demonstrate actual ecological thresholds. This seems to bear a similar logic to somebody that uncritically adheres to the ideals of the triple-bottom line SD framework. While SD may lead to an assumption of seeking win-win-win-situations, in practise avoiding trade-offs may be difficult.

Other composite indices have engaged to the measurement of environmental performance as such. However, also their content varies and their scores should be understood within their respective contexts. *Environmental Performance Index (EPI)* has been worked by a team of researchers in Yale and Columbia Universities in collaboration with the World Economic Forum and EU-JRC[56] and replaced the earlier *Environmental Sustainability Index (ESI 1999-2005)*. However, also the EPI in some sense seems to exemplify the dilemma of inadequate incorporation of the ecology as well as otherwise provides a few interesting and contentious insights to indicator construction. The EPI 2012 measures 132 countries (Yale 2012). However, many of the "strong performers" such as Switzerland 1st; Norway 3rd; France 6th; UK 8th; Finland 19th; Poland 22nd actually have very high carbon footprints. The weakness of EPI 2012 is similar to some SHDI proposals – they fail to *adequately* urge all industrialised countries to change their consumption and production patterns away from unsustainable performance in terms of climate change and resource consumption and also do not substantiate ecological thresholds. However, EPI can be seen to have some value in the identification of certain outliers: countries such as Australia (48th), the U.S. (49th), Qatar (100th) and Kuwait (126th) *do* lose positions significantly compared to GDP; and Costa Rica (5th), Slovakia (12th), Albania (15th) and Lithuania (17th) stand out positively. This might at least provoke the eyebrows of a few policy-makers. The actual mistake that the EPI seems to make demonstrates a flaw in reasoning during the research process. To begin with, the methodology of EPI has changed over the years, which make the EPI rankings incomparable, which in itself is a disadvantage. On the other hand, this can be justified because a model needs to be improved as more knowledge becomes available. Boumans (1999, 67), for instance, has described the process of model making "like baking a cake without having a recipe". The real question concerns the most recent EPI 2012, in which the authors suddenly decided to weigh climate issues *less* than in EPI 2010. According to the authors, the change follows the trends of international politics, and the researchers have considered the climate issue *less relevant* compared to what the situation was a few years earlier. Indeed, at the time of COP-15 climate issues had been high in the international political agenda but in a few years, the public, media and politicians had lost interest in the climate agenda (Media Matters 2012). While knowing that over time the need to react to climate change, a physical phenomenon, becomes more, not less urgent (Stern et al. 2006), such judgment seems odd and may communicate about a lack of rigour and analytic sense.

[56] The initial Environmental Sustainability Index (ESI) ranked Finland as Xth. while in the same year, the CO_2 emissions of Finland were the 9th highest in the world.

Whichever the case, using the same instruments, the EPI authors also piloted a new instrument called *The Trend EPI* (Yale 2012). In the Trend EPI ranking (2012), Latvia scores highest above Azerbaijan, Romania, Albania, Egypt and Angola. This indicator is a thought-provoking tool because it ranks countries according to *trends*, that is, either improvement or decline in their performance towards environmental sustainability. Positive or negative changes can, of course, reflect either endogenous or exogenous changes: outcomes of strategic and determined policy measures, or unintentional developments. In the case of climate change, economic downturns typically temporarily slow down the emissions rates of countries. Without really taking a stand on the usefulness of Trend EPI in itself, at least simple dichotomies based on time-series information can illustrate countries how they perform and make them actively monitored and evaluated.

Unlike sustainability-adjusted HDI measures or the EPI methodology, an indicator called e*nvironmentally sustainable national income (eSNI)* (Hueting 2013; Hueting et al. 1992) aims to define a maximum attainable production level up to which vital environmental functions remain available for future generations. Environment is defined as the physical surroundings that are non-human-made: water, air, soil, plant and animal species and the life support functions, including ecosystems. In practice, this means that eSNI calculates the difference between the present economy and an environmentally healthy economy based on available level of technological development (Hueting 2013). In order to define sustainability, eSNI employs three assumptions: first, the extinction of biological species at the global level may not be accelerated by human influence; second, any changes in the state of the environment may have only a minor, acceptable impact on human health; and third, that vital environmental functions need to be present all over the world (ibid., 90). Hueting argues that with these conditions, it is possible to outline environmental boundaries such as the maximum allowable level of global warming or pollutant concentrations. In the case of eSNI, the philosophy seems rather rigorous, as the ecological and moral considerations are transparently articulated.

Sustainable Net Benefit Index, SNBI (Lawn and Sanders 1999) calculates the loss of natural capital services, including pollution and environmental damage to constitute a final or "uncancelled" cost of economic activity. SNBI takes the stock of natural capital (oil, gas, coal, minerals, soil, timber, fisheries, and wetlands) as a foundation of any economic activity. Lawn and Sanders (1999), who in their original paper calculate SNBI for Australia for the years between 1966 and 1995, advocate SNBI as a better welfare proxy than GDP, arguing that it is at least better "to have a somewhat inaccurate but conceptually sound indicator than a performance indicator which is relatively

accurate but conceptually flawed". SNBI follows a similar type of methodology as GPI and ISEW, but Lawn (2005) prefers SNBI to ISEW and GPI because SNBI directly compares the costs and benefits of a growing macroeconomy. Again, the weaknesses of SNBI are related to the need of subjective judgement to make monetary estimates, measurement difficulties and lack of appropriate data. SNBI also struggles to adhere to the principles of strong sustainability and tell when ecological thresholds are crossed, even if a critical factor for a SDI is to signal when a country's absolute stock of natural capital becomes ecologically unsustainable (Lawn 2003; Neumayer 2000).

5.2 NGOs and think tanks in the promotion of new sustainability measures

An early example of SDI construction is the *Wellbeing Index (WI)* (Prescott-Allen 2001). WI measures human wellbeing (health and population, wealth, knowledge and culture, community, and equity: *Human Well-being Index, HWI*) and environmental wellbeing (land, water, air, species and genes and resource use: *EWI, Environmental Well-Being*). WI finds that in terms of human well-being, two thirds of the world population lives in countries with a poor or bad HWI. In terms of ecological well-being, countries that have a poor or bad state of EWI cover almost half (48%) of the planet's land and inland water surface. WI, though, rather looks at the quality of environments and human well-being than ecosystems health. WI has also been criticised for an arbitrary selection of measurable areas based on data availability (Parris 2002). Perhaps more usefully, based on these figures, *the Wellbeing/Stress Index (WSI)* compares the ratio of human wellbeing and ecosystem stress. At the time, the International Union for Conservation of Nature (IUCN) promoted WI and a *Wellbeing Assessment* to measure ecosystems and human wellbeing. IUCN has both NGOs and public sector environmental bodies as its members.

The Genuine Progress Indicator (GPI) (Cobb, Halstead and Rowe 1994) is amongst the most cited national SDI measures and a slightly modified version of *the Index of Sustainable Economic Welfare (ISEW)* (Daly and Cobb 1989), following John Hicks' ideas on sustainable income (1946). Methodolgicaly, GPI and ISEW begin their economic calculation from private consumption expenditure and *deduct* income inequality, costs of crime, environmental degradation, and the loss of leisure, whereas services from consumer durables and public infrastructure, benefits of volunteering and housework count as *positive additions* (Talberth et al. 2007; Cobb and Daly 1989)[57]. In order to measure sustainable economic welfare, the GPI and ISEW state to follow the

[57] $GPI = C_{adj} + G_{n-d} + W - D - E - N$,
where C_{adj} is personal consumption expenditures adjusted for income inequality, G_{n-d}; non-defensive government expenditure, W is non-monetised contributions to welfare, D = defensive private expenditure, E = costs of

principles of "no net loss of natural capital, welfare based accounting, distributional equity and throughput minimisation" (Talberth et al. 2007, 2). Promoted by Global Footprint Network and Redefining Progress, U.S.-based think tanks, the GPI and ISEW exercises have insofar only been practised in certain Western countries or smaller areas. Interestingly, in Finland, the first GPI calculus was in 2008 found "genuine progress" to have peaked in 1989, after which it has decreased into the levels of the 1970s due to increased income inequality and environmental factors (Hoffrén and Rättö 2013; Hoffrén 2010). In the U.S., the State of Maryland has adopted the GPI as its main measure of economic performance in budgetary and legislative decisions. Researchers have also calculated that in the U.S. between 1950 and 1997, the GPI per capita has decreased since the mid-1970s despite the aggregate growth of the GDP due to the continuous increase of income inequality; negative costs of lost leisure time and family breakdown; increasing foreign indebtedness and negative costs from the depletion of non-renewable resources (oil, gas and coal) (Anielski 2009). A consultancy for sustainability called the Center for Sustainable Economy has an International Program on Genuine Progress Accounts (IPGPA) to help policy-makers at national, state, and local levels to institutionalise GPI for performance measurement, policy analysis, higher education curricula, and media to provide reports on the state of our economy (Talberth 2012).

Some doubt the theoretical validity of GPI, ISEW and SNBI, but Lawn (2003) affirms that as they are based on Irving Fisher's (1906) concepts of income and capital, they are sound indices. As with the SNBI, the major weakness of GPI and ISEW is the inability to signify when an ecological threshold is crossed. Because they only subtract the cost of environmental damage, it seems that these indices should therefore be somehow supplemented or modified. Also Lawn (ibid.) suggests that more robust valuation methods in their calculation could lead to a wider acceptance of the threshold hypothesis. Remembering the assumption of the need of world's richest nations to urgently make a transition away from resource-intensive growth (Lawn 2003), in spite of their stated principle to minimise resource consumption, as consumption-based indices where human welfare to an extent inevitably relies on resource extraction (Moffatt 2008), in spite of their merits, I find them in somewhat a compromised position.

Then, there are some indicators that explicitly assume a policy-action perspective. *CCPI, Climate Change Performance Index* is published by Germanwatch and Climate Action Network (CAN) and was introduced in 2005 at COP-11 (Montreal) to measure the strengths and weaknesses of the

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environmental degradation, and N is the depreciation of natural capital base. In the GPI calculus, there are in total fifty-one items with either a positive or negative contribution, or both

national and international climate policies of 58 countries that together account for more than 90% of global greenhouse gas emissions (Germanwatch 2013; 2011). In the CCPI 2013, most countries get a *very poor* (Saudi-Arabia, Iran, Kazakhstan, Canada, Turkey, Russia, Malaysia, China, et cetera) or a *poor* (including the likes of Australia, Finland, Brazil and Norway) score. Denmark, Sweden, Portugal and Switzerland do *least* poorly and not a single country is given a very good score. The aggregate score is calculated based on emissions levels (30%); emissions trends (30%); policies (20%); renewable energy (10%) and efficiency (10%)[58]. In 2012, Germanwatch also started publishing the *CRI, Climate Risk Index* (Harmeling and Eckstein 2012) to analyse to what extent countries are affected by the impacts of weather-related loss events such as storms, floods or heat waves using available data from 1992 to 2011. For this time-period, CRI finds the most affected countries to have been Honduras, Myanmar and Nicaragua.

Then there is *LPI, the Living Planet Index* (Galli et al. 2012; Loh et al. 2005). First published in a WWF Living Planet Report in 1998 following a WWF project to measure changes in the world's biodiversity over time; the LPI reflects the quantification efforts to more systematically monitor the health of global biodiversity as also expressed in the Convention on Biological Diversity (CBD). The LPI measures trends in the global populations of vertebrate species living in terrestrial, freshwater and marine ecosystems with data available from 1970 onwards[59]. Between 1970 and 2008, the LPI observes a 30% decline in biodiversity health, a 37% decline in freshwater populations and a 70% decline in tropical freshwaters populations (WWF 2012, 8). In animal populations, LPI estimates of a decline of 28%. Many of these findings reflect human pressures on the environment: for instance in a half a century, the global marine fish catch has increased five-fold: from 19 million tonnes (1950) to 87 million tonnes (2005) (WWF 2012, 13).

Out of the two key measures in the WWF's biannual Living Planet Report, the footprint family, which at the moment, consists of the *ecological footprint (EF)*, the *carbon footprint (CF)* and the *water footprint (WF)*, has perhaps received even more attention than the LPI. Only in 1996 did ecologists Mathis Wackernagel and William Rees develop the concepts of ecological footprint and carbon footprint. Ecological footprint compares six anthropogenic pressures (built-up land, carbon, cropland, fishing grounds, forest and grazing land) to the available biocapacity, that is, nature's capacity to produce renewable resources. Biocapacity measures the amount of necessary land to

[58] Earlier, the CCPI methodology was: emissions trends (50%), emissions levels (30%) and climate policy (20%). CCPI uses energy data from the annual reports of BP and IEA

[59] Unfortunately, no data has been published prior to 1970, which disables the capturing of historic data to the LPI. See: WWF (2012, 2010, 2008, 2004, 2002, 2000, 1998).

provide for the resource requirements and vegetated land to sequester all CO_2 emissions[60] (Galli et al. 2012, 2007; WWF 2012)[61]. Expressed in units of area (global hectares, or gha), the largest single component of the EF is the carbon footprint (55%). In the national-level, National Footprint Accounts (NFAs) are applied to countries but ecological footprints may also be applied to other geographic areas such as cities or regions as well as industrial products. EF is a flow measure that estimates the total amount of productive hectares globally available.

In 2008, the Earth's total biocapacity was estimated at 12.0 billion gha that in average allocates 1.8gha for every person on Earth. Unfortunately, the EF for the whole of stood at 18.2 billion gha (or 2.7gha per person), which suggests that it takes 1.5 years for the Earth to regenerate the renewable resources humanity used in one year (WWF 2012, 38). In forty-five years (between 1961 and 2005) ecological footprints per capita have increased by 72% (Abdullah et al. 2009), and the allocated biocapacity per person has decreased from 3.2gha (1961) to 1.8 gha (2008). Today, Luxembourg, USA and United Arab Emirates have the highest ecological footprints. Also, an average citizen of United Arab Emirates (UAE) has an EF of 8.4gha, even if within the country there is only 0.6gha of biocapacity available per person. In the other end, Vietnam is a more positive case example with a low EF (1.3gha), but nevertheless a high life expectancy and life satisfaction. This is called the 'earth-equivalent ratio' (*EFBIO),* which can be employed to compare per capita ecological footprints against the per capita globally available bio-capacity (Moran et al. 2008). EF effectively illustrates how increases in well-being have followed the increase of material consumption and how urbanisation for instance leads to growing ecological footprints.

Carbon footprint is an individual consumption-based measure that calculates the total amount of greenhouse gas emissions accumulated directly on-site (internal) and indirectly off-site (external, embodied, upstream, and downstream) over the life stages of a product (Galli et al. 2012). CF is expressed in mass units (unlike for instance EF that is measured for an area). Governments, industries, companies, organisations and individuals alike have employed the carbon footprint since it was introduced in the early 2000s (Wiedmann and Minx 2008)

However, it might be questionable whether even the EF adequately represents the human impact on environment (Sciubba 2013; Fiala 2008; Hueting and Reijnders 2004). Fiala (2008) criticises EF because it does not explicitly address the issue of people's consumption as the driver of

[60] And the CO_2 emissions embodied in the products consumed
[61] For a detailed explanation of the mathematics of EF, see: Galli et al. 2007

environmental pressure; as well as the failure of EF to capture land degradation or acknowledge technological change. Hueting and Reijnders (2004) note that in spite of its focus on the ecosystems, the EF focuses on stocks instead of flows and is only able to give static figures and cannot capture the underlying processes in the ecosystems. Also, for some (see: Fiala 2008), the use of global averages often employed by EF rather makes it a measure of inequality than sustainability. Fiala (ibid.) would prefer direct measures of land degradation and aggregations of emissions levels.

The newcomer to the footprint family is the water footprint (WF) that estimates the volume of freshwater that is required *directly* or *indirectly* to produce goods and services (Galli et al. 2012; WWF 2012; Hoekstra 2009, 2003). The use of national water footprint accounts can exhibit the use of water both inside a country and in other countries, and is thus able to demonstrate that several countries rely on foreign water resources. In essence, many Western citizens who enjoy from quality products made elsewhere, have contributed to water consumption and pollution elsewhere (Hoekstra and Mekonnen 2010). WF measures the green water footprint (consumption of rainwater); the blue water footprint (consumption of surface water and ground water) and the grey water footprint (volume of water required to maintain water quality). WF also finds that 2.7 billion people who live in catchments, that is, natural drainage areas, experience water shortage at least one month a year (WWF 2012).

Despite of their limits, Galli et al. (2012) suggest that by presenting a quantifiable and rational basis that complements traditional analyses, the footprint family (at the moment EF, CF and WF) may enable the improvement of efficiency in production processes. Also, these measures succeed in coupling the producer and consumer perspectives together (ibid.). To standardise these measures, the Global Footprint Network has developed National Footprint Accounts as well as application and communication standards.

The New Economics Foundation (nef), a London-based think tank has promoted ideas based on findings in ecological economics[62]. *The Happy Planet Index (HPI)* (NEF 2012, 2006) has received considerable attention. Methodologically, the HPI extends the HLY measure of "happy life years" (Veenhoven 2004) and divides it with the ecological footprint[63]. Ranking 151 countries (NEF 2012), not a single country scores the highest points in all three dimensions (subjective well-being,

[62] In 2004, NEF also published a Measure of Domestic Progress, an adjusted economic indicator, which methodologically is close to the GPI and ISEW indicators.
[63] HPI = HLY / EF = (SWB * LE) / EF

life expectancy and ecological footprint). Costa Rica received the highest score thanks to high life satistfaction and high life expectancy and only a modest ecological footprint (2.5gha a little above the global target of 2.1gha). Costa Rica is followed by Vietnam, Colombia, Belize and El Salvador. Many well performing countries are Latin American and/or island states such as Cuba, Dominica and Jamaica and the Philippines (Abdallah et al. 2009). High ecological footprints (UK: 41st; Korea 63rd; USA 105th; Luxembourg 138th; Qatar 149th) make most industrialised countries fare less well. However, most poorly performing countries are developing countries (CAR 148th, Chad 150th and Botswana 151st). The authors note the HPI to exclude Bhutan due to lack of data, even if in many sustainability measures the country has performed well. A related *Charter for Happy Planet* calls for the so-called developed countries to reduce their respective ecological footprints to 1.7ha by 2050 and developing nations by 2070, while increasing their life expectancy.

HPI is simply an efficiency measure that scrutinises how many long and happy lives countries are able to produce per unit of environmental input (NEF 2012) and this message communicates effectively. The HPI scores are likely to upset highly consuming countries because countries with low living standards in material standards score well. Some have criticised the HPI for suggesting that countries like Cuba (12th) are doing dramatically "better" the UK and the US. Of course, this is what development is about, and because the HPI lacks a monetary component, material well-being plays a more marginal role, even if it enables the citizens of industrialised countries to live longer and on average be more satisfied with their lives too. A more genuine criticism is the fact that the HPI is unable to consider the extent of opportunities (Sen 1999), human rights or political freedoms. Therefore, "pro-democracy" enthusiasts are likely to be the first to condemn the index. I would argue that their criticism is valid and should perhaps be addressed in the factoring of the "human side" of the equation, but the HPI does very well demonstrate the current unsustainable consumption patterns. The critics of HPI might also be misled in assuming that any progress indicator should give "developed countries" favourable scores. On the contrary, their mission is to challenge our conventions of thinking and provoke policy-makers to ask the inconvenient question and see that economic development expands consumption choices, but comes with an ecological price tag.

5.3 Intergovernmental institutions and the SNA as a centre of calculus

"The SNA is a system of accounts measuring "stocks of, and changes in, economic value and to identify the person, group of persons, legal or social entity with claims on the economic value."

(SNA 2008, Chapter 3: Stocks, flows and accounting rules)

As has been earlier discussed, in 1947 the United Nations (UN) started to develop the *System of National Accounts (SNA)* as post-World War II reconstruction emphasised the necessity of the growth of national economies (Abdallah et al. 2009; Talbert el al. 2007). Since the launch in 1953, revised SNA editions have been released in 1968, 1993 and 2008 with updated instructions, handbooks and manuals. In the Cold War era, socialist countries followed a similar system to the GDP, the Material Products Accounting System (MPAS) (Vilani 2005). Also other countries such as France, the U.S., and China employed their own statistical systems. With necessary conversions, these systems have been integrated to the UN-facilitated SNA framework. As adopted by the decisions of the UN Statistical Commission, and managed by the UN Statistics Division, the SNA is an integrated system of accounts for the purpose of international comparisons of all significant economic activity that internationally connects and instructs national statistical offices. Following the work of the UN Statistical Commission (UNSC) and the international statistical community, the most recent, System of National Accounts (SNA 2008) consists of 664 pages of accounting rules[64]. Interestingly, the SNA (2008, Annex 4) states that it aims to give "a realistic and compact view of the economy that is suitable for policy-making and analytical use". Indeed, recently it has addressed the issue of the recording of tradable emission permits (UNSD 2011).

Since 1990, the UNDP has the HDI at the heart of the annually published Human Development Reports (HDR). In the UN System[65], in which individual UN agencies and programmes have highly independent mandates, roles and varying membership structures, UNDP is a type of a coordinator. In turn, the main environmental institution in the UN is UNEP, which has never been in a similar institutional position (DFID 2011, 195; Meyer-Ohlendorf and Knigge 2007; Ivanova 2007)[66]. In 1999, *Environmental Vulnerability Index (EVI)* was developed by UNEP that wanted to examine

[64] The 2008 SNA was prepared under the Inter-Secretariat Working Group on National Accounts (ISWGNA), consisting of Eurostat (on behalf of EC), IMF, OECD, UN Statistics Division, regional commissions of the UN, UN secretariat and World Bank

[65] For instance, the UNDP Administrator is the third highest official in the whole of the UN System

[66] Only until recently, UNEP has worked mostly in the environmental sector of the developing countries. Compared to other international bodies (WTO, WHO or ILO) in their respective sectors, UNEP has had fairly limited voice and influence. Also the location of UNEP in Nairobi limits its international influence because the UN is headquartered from New York and also Geneva is another important centre of UN-based diplomacy. UNEP has mainly worked through technocratic approaches such as policy reports and environmental data that has been published in scientific expert contributions such as the Global Environmental Outlook (GEO) series and the Global Biodiversity Assessment of 1995. After years of calls from certain countries, the Rio+20 Conference finally agreed to "strengthen and upgrade" UNEP so that it could better respond to emerging global challenges. This also enabled a universal membership structure to the UNEP Governing Council, the main governing body of UNEP and will increase the UNEP budget. The UNEP budget has been considerably lower than the budget of UNDP or other major expert-UN agencies like the WHO

the vulnerability of small-island developing states. After testing five countries in 2001, the final version was launched in 2005 but with no apparent follow-up. Under the auspices of the Commission on Sustainable Development (CSD), the UN also has hosted an indicator set of sustainable development (*the CSD indicator set)* with three editions: 1996, 2001 and 2006. The 2006 set, conducted by a group of experts from international organisations and developing and developed countries, lists 96 indicators and 50 core indicators. However, the CSD never managed to achieve a leadership role in the UN and in the Rio+20 conference, member states terminated the CSD. Out of indicator sets, the UN Millennium Development Goals (MDG) framework has at least been in operative use in development policy and aid frameworks.

Recently, though, the UN agreed on the principles to publish environmental-economic accounts under the *UN System of Environmental-Economic Accounting (SEEA)*. UN SEEA is a measure of green national accounting that adapts the national income to environmental losses. Like the SNA with the GDP, UNSEEA aims for a standardisation of calculus methods with the national statistical offices. Finally, it is perhaps worth mentioning that within the UN, countries report of their carbon emissions to yet another separate UN institutional structure, the UN Framework Convention on Climate Change (UNFCCC)[67]. The UN mechanisms of measurement can thus be criticised for the lack of incorporation of the ecological dimension on the most parts (SNA, HDI, MDGs) or the weakness of institutions or institutional mechanisms that address ecological issues. UN SEEA that has been now launched is a system of green accounting. However, as noted, the deficiency of these *additive* monetary-based SDI systems is their inability to account for ecological thresholds, and the UN SEEA also does not account for social losses. UN SEEA is, however, perhaps a step forward from the more conservative (and to some, theoretically outdated) SNA accounting system.

The European Union (EU) has employed the *European System of National and Regional Accounts* (ESA 2010, 1995), which in turn adheres to the UN SNA rules and classifications. The European Parliament recently approved and revised the ESA to "align with the recent economic and statistical developments" and the EU Member States will implement it in 2014 (EC 2010). In the area of SDIs, the EU has published the EU SD indicator set, which when published in 2005, consisted of 155 indicators. Today, the EU Sustainable Development Strategy is monitored with eleven headline indicators that are categorised under four (economic, social, ecological and institutional) themes

[67] The UNFCCC hosts a small secretariat in Bonn, Germany. As it is known, despite the continuous increase of climate emissions, climate talks between countries have stalled for years. After the initiation in the original 1992 Rio Conference and the Kyoto Protocol, in 2011 in the COP-17 meeting in Durban, South Africa, it was agreed that a new legally binding climate agreement would be negotiated in the 2015 COP-negotiations and take effect in 2020.

(Eurostat 2012). Over the years Eurostat, the main statistical body to provide statistical information to EU institutions, EU member states (and aspiring member-states) and EFTA countries, has also assisted the UN in the testing of new SD indicators. In 2007, the European Commission initiated a four-year project called "Beyond GDP" to search for alternative measures of progress – a project that has been mentioned earlier in this paper.

OECD, The Organisation for Economic Co-operation and Development, has published indicator sets since the 1990s. Also, from 2004 onwards every 2-3 years the organisation has held a high-level policy forum on "Statistics, Knowledge and Policy", or the OECD World Forum. In 2008, OECD established The Global Project on Measuring the Progress of Societies to assess, how the well-being of a society is evolving[68]. Of course, the OECD also publishes a number of other reports such as the influential OECD Economic Outlook. In 2011, the OECD initiated the OECD Better Life Initiative. *The Better Life Index (BLI)* was published in the following year. BLI ranks the 34 OECD member countries and examines eleven topics: income, housing, jobs, community, education, environment, civic engagement, health, life satisfaction, safety, and work-life balance. In the BLI ranking, Australia scores highest, followed by Sweden, Canada, Norway, Switzerland and the U.S. The online version of BLI also lets individual users to learn with the parameters, enabling the creation of "your own Better Life Index". The scope of BLI is rather limited and it seems to not give direct policy advice. Rather, it summarises information to countries with pre-determined categories that it considers essential to "a better life", and lets countries themselves to make the conclusions.

The World Bank, these days a driving force in the international development debate that recently has opened its development data to promote open data policy (Zoellick 2010) hosts the World Development Indicators (WDI) database that measures a range of development issues. Nonetheless, like the EU, the Bank adheres to the UN-hosted System of National Accounts (SNA) and publicly uses the gross national income (GNI) as its *main* figure to classify countries[69]. The main SDI employed by World Bank has been the *Genuine Savings (GS)*, or *Adjusted Net Savings (ANS)* indicator, a flow measure that tracks changes in the stock measure of *Total Wealth*. As an accounting measure, the GS states that it aims to take into account the investment in human capital, natural resources depletion and pollution damage. GS follows the theories of Solow (1974),

[68] Thorough description about the project is available on the project's Wikiprogress website
[69] For World Bank, the country groups are low income (USD 1 025 or less); lower middle income (USD 1 026-4 035); upper middle income (USD 4 036-12 475) and high income (USD 12 476 or more) (World Bank 2013b). Previously, the Bank had used the gross national product, GNP (ibid.).

Hartwick (1977) and Hicks' (1946) on sustainable national income where the maximum amount a community can consume in a year holds the condition that the community is also able to produce and consume the same amount the next year (Daly 2008; Dietz et al. 2007). GS aims to maximise intertemporal social welfare in an economy that exploits non-renewable resources.

According to the GS logic, a decrease of natural capital should alert policymakers because it both *currently* reduces the income-generating capacity of an economy and endangers the opportunities of *future* generations that should benefit from the same resources (Lange 2003). However, although the GS is a rather visible indicator, it is considered one of 'weak sustainability' (Hueting 2013; Dietz et al. 2007). Hoffrén (2010) suggests that the GS/ANS indicator neither sufficiently acknowledges climate change, resource consumption, other environmental considerations nor pays sufficient attention to subjective well-being. Also others (Huang and Quibria 2013, Pineda 2012) criticise the GS for its assumptions on consumption growth, discount rates and asset lifetimes as well as its narrow economic view on human capital and wealth that ignores social capital in the shape of trust, respect, altruism, culture and institutions. Hamilton et al. (2010) acknowledge that as a production-based, rather than consumption-based measure, the GS in its ranking of countries may provide a distorted picture where many developing countries that produce and export natural resources "seem" unsustainable. This is, indeed fallacious, as developed nations are the ones that in reality have high consumption patterns as they import these resources, often even using companies companies that even benefit their own national economies.

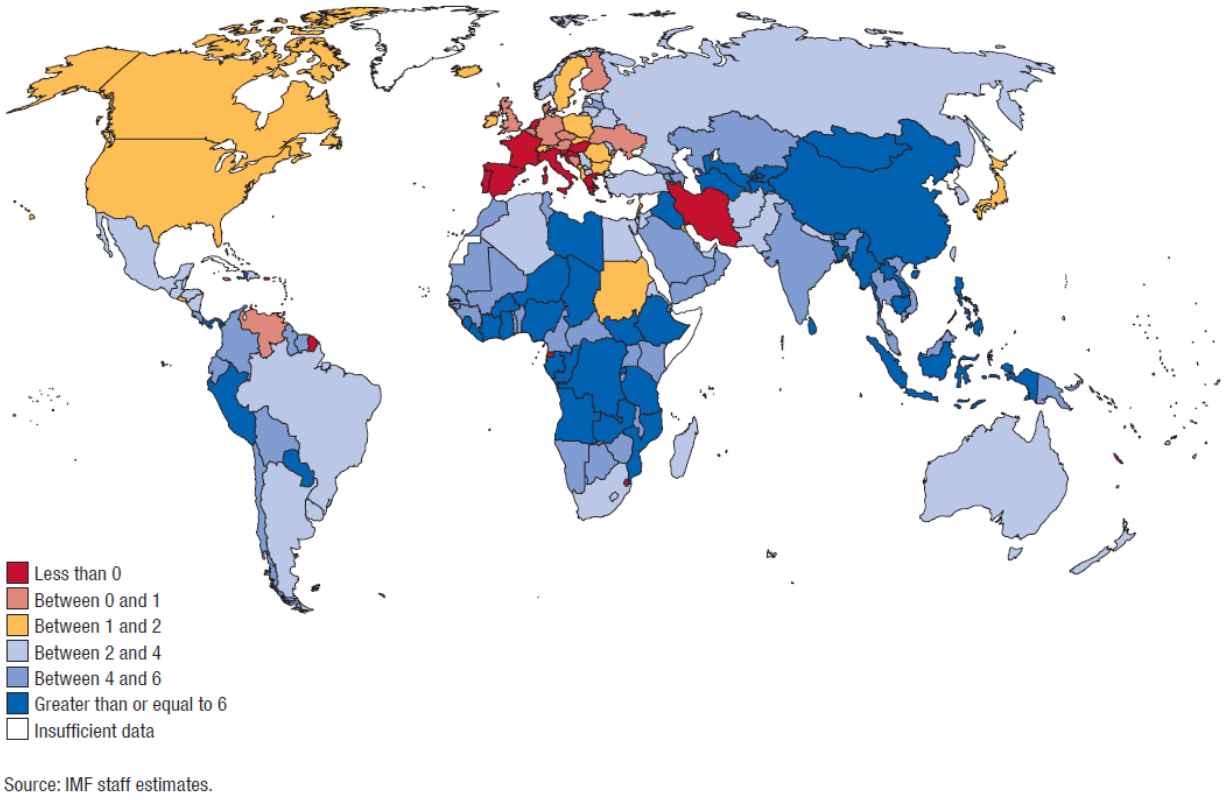

Image 8: World 2013 GDP growth forecasts (percent) (Source: IMF 2013a, 45)

Finally, in guiding the global economy, the International Monetary Fund (IMF) also has a central role in providing policy advice as well as financing its member states in economic difficulties. The IMF publishes the World Economic Outlook twice a year to instruct the decision-making of national ministries of finance, which in turn influences the national economic forecasts and other sector policies. I argue that the IMF policy advice can also be understood as influential signals and indicators that advice policy-makers about worthy goals, as demonstrated by the exemplifying illustration above *(Image 8)*. As an international financial institution, IMF "oversees the international monetary system and monitors the financial and economic policies" (IMF 2013b) the 188 member countries of the IMF.

5.4 States in the pinch of the macroeconomic growth imperative

Eventually in a comparative setting, states are the units that are measured, even if Fiala (2008) considers using nations as boundaries for measurement an arbitrary choice because they hide intra-country disparities, and from an environmental perspective historical and administrative boundaries are largely irrelevant. Anyhow, in the previous chapters, I have exhibited the performance of

different countries through an overview of different indices and the scores that they assign individual countries with. Already, it is clear that the choice of approach affects the ranking position of a country, and therefore, it is important to first see what a SDI is actually measuring, and only then make an informed judgment of the sustainability performance of a country. Generally speaking, though, countries that perform well in sustainability indicators typically have low ecological footprints and modest carbon emissions. These countries seem to be economically mainly non-industrialised countries; income-wise – to use the World Bank-language – at best middle-income countries; often rather small in size; and in addition endowed with renewable energy sources, a reason for which they may be even able to generate a considerable amount of their energy using energy sources such as hydropower or perhaps geothermal energy.

Such is the case of Costa Rica, for instance, a country with a rather small geographical area, which is often cited as an example of "a sustainable country" as it performs rather well in various composite SDIs such as HPI, EPI and ESI. Costa Rica is a middle-income country, which mostly relies on hydropower (nearly 93% of national electricity is generated by renewable sources and the country may target carbon-neutral electricity generation in the near future) (García Sanchez 2012). As mentioned, the population has a high average life expectancy of 79.4 years (HDR 2013c, 2013a) and a moderate ecological footprint. Perhaps it is good to also consider the aspect of country branding, because ecologically sustainable tourism is now an important economic attraction of Costa Rica. The downside, however, is that despite its stated long-term aim of full carbon neutrality, an indefinite expansion of hydropower may not be possible due to likely controversies with the social impacts on local livelihoods and the need not to only generate energy, but to conserve ecosystems (ibid., 12).

In contrast, practically all industrialised countries are unsustainable countries, if the principles of strong sustainability are employed and carbon emissions are considered. According to Pineda (2012), 90 out of 185 countries have their per capita emissions above this planetary boundary. If nothing else, economic development has also enabled the development of statistical institutions and knowledge as well as the employment of different types of national SDIs and management strategies in developed countries. In the UK, the country employs a national SD indicator set of fifteen headline indicators (Moffatt 2008, 82). In Germany, the SD Indicator Report 2012 is a review of the linkages of national policies and the indicators of sustainable development. Furthermore, a sustainable development strategy has become at least somewhat rooted into the political system of the country. In addition, countries such as U.K., Canada, Australia and New

Sealand have also experimented wellbeing measures (Canoy and Lerais 2007). For instance, in the UK the Office of National Statistics (ONS) has experimented on the calculations of the value of social and human capital (Hicks 2011). However, Buttel (2000, 62) warns that these types of policy measures may not be easy to implement in all nation-states[70]. For instance even in Finland, which belongs to the group of countries that high carbon emissions and a high level of statistical capacity, the national SD strategy may have only achieved modest political impacts (Rosenström 2009).

Recently though, also non-Western countries have joined the SDI boom. In the Asia-Pacific region, there are various initiatives for national-level indicators such as the *Thai Sustainable Development Index, Korean Sustainable Development Index, Thai Gross Domestic Happiness* and *Malaysian Quality of Life* (see: Gennari 2007). Then there is the case of China, a country where environmental policymaking has been undermined by information gaps, asymmetries, and limited public access (Hsu et al. 2012). Recently, *the Resource and Environmental Performance Index (REPI)* was developed by the Resource-efficient and Environment-friendly Society (REEF) and approved by the Chinese National Academy of Sciences. REPI measures a country's eco-efficiency by quantifying the consumption of selected resources and pollutant emissions per unit of GDP. Thus, as a relative indicator, REPI encourages for maximum efficiency in resource use with minimal pollution and other environmental impacts (UNESCAP 2012, Chen and Wang 2008). In China, where emissions, pollution and energy consumption have all surged, achieving resource efficiency is understandably a vital goal, and REPI was integrated to the country's 11th Five-Year Plan. However, a study by Chen and Wang (2008) that studied 59 countries as well as China's 31 provinces gives a more pessimistic message. They (ibid.) suggest that although China may be able enhance its sustainability performance, by and large its development trajectory is bound to follow resource- and energy-intensive industrialisation. These kinds of warning signals should alarm policy makers throughout.

One national-level indicator, however, stands tall above others in reputation. Undoubtedly, the biggest amount of international attention has been paid to the Bhutanese *Gross National Happiness (GNH)* measure, which is all the more interesting considering the fact that Bhutan is practically a non-industrialised country – and typically "developing countries" have been considered to have less statistical capacity in their state machinery to use such technologies. The GNH is a multidimensional index consisting of four dimensions: equitable social development, cultural

[70] For more discussion on national SD initiatives, see e.g. Gjoksi and Sedlacko (2011), NSDS-Germany (2010), Rosenström (2009) and other strategies: e.g. UK DECC (2011)

preservation, conservation of the environment and the promotion of good governance, and it is measured with 72 sub-indicators. The fourth King of Bhutan, Jigme Singye Wangchuck (1972-2006) ruled the country according to Buddhist beliefs. And, unlike many Western notions of happiness that have mainly focused on psychological, subjective well-being, in the GNH measurement the dimension of harmony with nature is included.

In some level, Bhutan may also be said to living up to its own standards. Officially, the country states that the happiness of the people of Bhutan in terms of GNH precedes the influence of GDP (Thinley 2012; Govt. of Bhutan 2000). In addition, the Bhutanese Constitution demands a minimum forest cover of 60%, and 50% of the country is under full environmental protection in order to protect biodiversity, ecological corridors and safeguard watersheds (Thinley 2013)[71]. As a mountainous country in the Himalayas, Bhutan is also able to generate its energy with hydropower, making the country score high on the climate dimension. The critics of this case study will likely point to these factors as contingencies that condition the country to such a remote location. And remote Bhutan has been, "inhabited wilderness" (Ito 2011) and a country with no roads before it opened up to the world in 1961. First group of non-Indian tourists only arrived in 1974 (ibid.). Prior to the 1990s, the country practically had no televisions. Because traditionally a large part of the country's rural economy has been non-monetised (Govt. of Bhutan 2000, 14), the Bhutanese GDP is rather low. The critics of the Bhutanese case can also increase the strength of their argument in referring to conventional development figures. By (monetary) poverty measures, 23.2% of the Bhutanese people is estimated to live below the poverty line and even in non-monetary measures, only 53% of the country's adult population is literate[72] (WDI 2012). But the technological advancements of recent decades have made the country experience a tremendous upward trend on many fronts. Average life expectancy now stands at around 67 years (47 years in the mid-1980s and 33 years in 1960), Bhutanese people are able to enjoy of free education and healthcare and basic infrastructure such as roads and communication systems have improved considerably from the 1960s onwards. A fairer assessment would perhaps state that from the income perspective, Bhutan has remained "underdeveloped" and to some extent is, in many other measures, the example of Bhutan at least theoretically signifies about a balance that may be worth pursuing for.

[71] According to Thinley (2013), during the past 50 years, the forest cover of Bhutan has actually risen from 60% to 80%
[72] Using 2007 figures. The 23.2% figure follows the USD 1.25 per day poverty line. The USD 2 per day poverty line defines 36.9% of Bhutanese to live in poverty.

Future, however, holds further challenges to Bhutan; a country that still today vigorously tries to protect its traditional culture. Additional roads will increase the pressure on biodiversity and may also increase the reduction and fragmentation of wilderness areas (Ito 2011). Culturally, Bhutan is experiencing an on-going struggle between traditional culture and Western values (Buncombe 2012), in which the society is forced to find its way.

> "My deepest concern is that as the world changes, we may lose the fundamental values on which rest our character as a nation and people. It is critical that we are able to recognise Bhutanese character irrespective of how far we look back into the past or into the future."
>
> (Coronation Address of the King of Bhutan, His Majesty Jigme Khesar Namgyel Wangchukto, November 6, 2008)

This argument about Westernisation against indigenous ways of life could perhaps also be discussed through an examination of the 'romanticisation' argument, or that of how modern development is also portrayed to bring negative effects in societies (Veenhoven 2012). Veenhoven (2012) suggests that when a very undeveloped society is compared to a developed society, the merits of technological progress are well understood: agrarian societies have typically had limited access to healthcare services and modern formal education, lower levels of freedom and less opportunities to entertainment. In contrast, economic development has granted increasing autonomy and freedom due to division of labour and specialisation; countless innovations and improved technology have facilitated the meeting of basic needs, connectedness and provided entertainment to the human life (ibid.).

However, the picture might be more nuanced than Veenhoven (2012) proposes. For instance Brockington (2006) has studied environmentalism in Tanzania suggests disconnects between the higher-level policy debates and people's aspirations in the village-level where he finds simultaneous attempts to "bring development" and conserve the environment. Secondly, while limitations in the access to basic services as well as entertainment may still hold true to many agrarian or indigenous societies, connectivity through technological globalisation is reaching the far corners of the world at an increasing pace. And thirdly, at least for many pastoralist communities, state-led development solutions have often offered largely inadequate solutions to meet the needs of nomadic lifestyles – them too finding arbitrary state boundaries a troubling trait of the Westphalian system. In his classic, but controversial article "The Clash of Civilisations", Samuel P. Huntington (1993, 40-41) outlined different strategies of "the Rest" to balance between their own indigenous values against Westernisation. But whereas Huntington's analysis, a *realpolitik* classic of the post-Cold War years emphasised economic and military power (ibid. 41); an idealist viewpoint would

look at the resistance strategy of providing an ideology superior to the of the oppressor, or one finding cooperative means of integrating the two – indigenous and exogenous influences. In sum, Bhutan gives interesting food for thought for those who have considered Western values and technology-led economic development as the *only* viable development paths, and in the process have thought employing GDP figures is the sole means of measuring progress. And in my view, it signifies about a need to balance valuation techniques between idealist and materialist values regardless of the country context. Whether the GNH is the indicator fit for the job can perhaps still be further examined.

5.5 Analysis: Institutional motives influence the framing

Having discussed different initiatives and interests of different actors, here is room to make some observations. First of all, the strength of academia is its knowledge capacity and rigour in studying areas that other actors would lack capability to do, as well as integrity that other constituencies might be constrained by. However, while some ideas are able to move from the bottom to the top and vice versa, certain discursive interaction of expert communities (Haas 1992) may also remain within closed circles. And even in spite of advocacy efforts, some new ideas may not be approved simply because they are seen too progressive or controversial (Schmidt 2008, 311). While it seems that SDI proposals have largely remained constrained in isolated circles outside the political action of intergovernmental institutions and the state, this might also have to do with the capacity of academics to influence the policy debate, which is often limited by the insecurity symptomatic to a large part of the members of the scientific community.

Instead, many think tanks and non-governmental organisations have engaged in this task and picked on the work of researchers or created indicators of their own. Also at times, researchers have themselves become affiliated with these think tanks. It seems that the advocacy work and knowledge creation by actors such as Climate Action Network, Germanwatch and WWF, or think tanks such as New Economic Foundation and Global Footprint Network has been able to raise political attention to concerns and viewpoints about ecological thresholds that otherwise would perhaps not have penetrated the public awareness[73]. A lot of their work seems to fare rather well in illustrating the human pressures on ecological sustainability. Although even the CCPI, LPI, HPI and the footprint family might struggle to substantiate all ecological thresholds, at least they seem to adhere to a rather strong notion of sustainability to guide a policy-maker's attention explicitly to

[73] In the case of non-governmental organisations, I find this observations in particular interesting because the world of NGOs has traditionally organisations into developmental NGOs and environmental NGOs.

assess the human impact on the ecosystems. Of course, their work should also be held subject to critique, especially it such institutions commission research that fits their own motives, which is what they typically do. In the field of evidence-based policy-making where advocacy organisations are evidently more enthusiastic to make recommendations than academics, it would seem fair to think that any proposals that arise from this half-academic-half-policy-oriented community should also be scrutinised through an academic assessment, and improved if necessary. If they then pass, such proposals will not only have political interest but theoretical backing as well. However, the dependency on external resources and project funding (Lyytimäki et al. 2013) of non-state actors could undermine the abilities of academia and non-governmental institutions to construct SDIs that attain visibility. This emphasises the role of institutions with financial and knowledge resources.

Indeed, the UN, OECD and the World Bank have had a significant influence in development thinking and ideological and theoretical changes have also changed the interest in research (see e.g. Jolly 2004). Erkkilä and Piironen (2009, 129) suggest that the style of supranational actors is actually similar to historical attempts to make the state calculable. More recently, these institutions have also become increasingly involved with environmental work (see also: Ivanova 2007). In the field of social indicators, 1960s and 1970s saw breakthroughs in the measurement of social welfare whereas in the 1980s and 1990s interest turned purely to economic issues, politically correct country profiling and case study approaches (Prasad 2004). The "neoliberal turn" even brushed established institutional and knowledge resources aside, such as UNRISD's work on social indicators (ibid.). Development and poverty indicators of the UN have captured and visualised deprivation, but also diverted the attention of the deficiencies of the international system and global politics. However, some of the most influential of narratives, development policy reports and related statistics are drafted in a constrained international system of bargaining, negotiations and vested interests.

The UN is a product of the post-WWII era, much a human development-oriented institution with tied hands in many ways. The UN is typically considered an intergovernmental organisation only as strong as the mandate given to it by the member-states. National interests limit the political agenda, policy space and funding of the UN, and this is also reflected in the UN System itself where member-states have chosen to fund certain policy areas more than others. The limited role of UNEP makes a case in point. Limited in its scope, one might also suggest that UNEP has been targeting the wrong group of countries – after all, industrialised countries bear the highest consumption patterns. Within the UN structure, possibly the most influential advancement away from the

mainstream measurement so far is the adoption of UN SEEA. This new standard, adopted in 2012, will influence national statistical offices, which traditionally have been more habituated to monitor income and product flows in the national accounts (SNA) rather than natural capital assets (Lange 2003, 15). In Bruno Latour's (1987, 232) terminology, the UN is a highly relevant "centre of calculus", as in spite of it weaknesses, it is the main and only intergovernmental body where all countries of the world are represented. And in this structure, the UN Statistics Commission and the UN Statistics Division seem central to the development of the calculus effort.

In a regional level, the European Union also has vast knowledge resources that it can employ for many purposes as it has with the Beyond GDP research. Implementation, though, may be another question in an organisation of diverse member-states. At heart, the European Union is an economic union, which is why EU in general has been deemed to promote "weak sustainability" (Baker 2006). The EU has rather become internationally known for its internal contradictions and a selective adherence to the free-market principles (Stocchetti 2013), implementing its incoherent policies "in the full glare of publicity" (Carbone 2008). Perhaps partially also for these reasons, Hoffrén et al. (2011, 2) have suggested that the EU needs new planning and evaluation tools for sustainability as well as new indices for macroeconomic planning and strategic decision-making.

Southwest of Brussels, the Paris-based OECD has had a central international role using knowledge as power ever since it was founded in 1961[74]. The polluter pays principle, introduced by the OECD in the early 1970s, made way for future environmental policies and the OECD also promoted the environmental pressure-state-response framework (Atkinson and Hamilton 1997). The OECD also influenced the articulations into the 1987 Brundtland Report that set about the SD discourse partly thanks to strong personal connections between the institutions (Bernstein 2002), managing to promote the positive linkages between environment, economic growth and economic instruments. However, in the interaction between the organisation and the national ministries the OECD is an institution whose economic reports may be assumed to have been more institutionalised to the nexus of state interaction rather than its work with SDIs. Furthermore, the views of the OECD may be constrained by political and member-state interests. Also for this reason, the SDI rankings of the OECD may need to be interpreted under the atmosphere of political sensitivity.

On the other side of the sea, the mission of the Washington D.C.-based World Bank that was

[74] OECD Publishing is one of the world's largest publishers in economics and public affairs with electronic materials accessible as well

founded post-WWII as a part of the 1945 Bretton Woods arrangement to provide states with loans for post-war reconstruction has now turned to one that is giving policy advice and devising development strategies. The Bank's institutional position is not without tensions. Over the years, the Bank's governance indicators have been found to emphasise functioning markets more than democratic virtues (Erkkilä and Piironen 2009, 139). The Bank also advocates its *Doing Business indicator* with press conferences, road shows, workshops and a website, even making The Economist its strong proponent (Davis et al. 2011, 34–35), which at least suggests that economic indicators have likely been given more attention than environmental indicators. Recently a campaign[75] criticised the World Bank methodology in its *Employing Workers Indicator (EWI)*, considering the indicator biased towards labour market deregulation. This forced the Bank to abandon its use in favour of a new indicator that was closer to the labour standards of the ILO. In the area of poverty, Reddy and Pogge (2005) have been critical of the WB poverty line measure, and perhaps also implicitly seeing the Bank to have too big of an influence over this agenda. Recently, however, the World Bank has endorsed the climate change dilemma more actively than ever before, and even committed itself to the phase-out of lending money to coal projects (Oil Change 2013). Nevertheless, some of the imperatives of environmental regulation and climate change mitigation may still fundamentally be in conflict with its neoliberal economic policies (Newell and Paterson 2010; Bernstein 2002). Goldman (2005, 5) aptly calls this "green neoliberalism".

International financial institutions by nature prefer market-based approaches, and it is perhaps telling that indicators of green accounting such as the Genuine Savings of World Bank fail to take into account ecological thresholds, and ultimately support the growth of the economy. All in all, instead of advocating for a particular SDI, intergovernmental institutions have rather expanded the provision of data, publication of different indicator sets and the techniques of data collection. Also the OECD Better Life Index rankings are inviting, but rather conservative. The boldest might even claim that in the end of the day, they are more of a publicity exercise than an actual ecological scrutiny of member states. Rankings should be taken with a pinch of salt, because lack of clarity is something to be expected from organisations with internal tensions about political objectives. However, it is also worth noting that the SDIs they promote tend to seek a marriage of environmental and ecological dimensions but seem to take less active a stance towards the social dimension of sustainable development. While climate and environmental issues seem to have

[75] The campaign involved members of academia, politicians, NGOs, ILO and ITUC

penetrated intergovernmental institutions, the substantial role of these issues within the organisations has been less significant. Furthermore, the governance structures of the World Bank as an international financial institution and the OECD as an economic organisation represent the interests of the industrialised economies (see also: Patomäki and Teivainen 2003).

The IMF has not constructed SDIs and hardly addressed sustainable development either. However, there is a good reason to argue that it is a significant stakeholder to the political debate. In the turn of millennium, anti-globalisation critics (e.g. Patomäki and Teivainen 2003; Easterly 2003) for providing policy advice that overemphasises economic liberalisation and privatisation in the expense of the public sector service. With the recent global economic crisis, the criticism against the IMF austerity policy has again raised its head (Krugman 2012). In turn, ecological economists and environmental policy researchers (e.g. Newell and Paterson 2010; Daly 2008) have been critical of the IMF and the WB because minimal regulation of global trade and financial flows almost inevitably hinders any attempts to control the social and environmental impacts of capital movements as well as limits the design of multilateral measures upon which climate change could be controlled. I would further argue that while this may be likely; the role of IMF as an influential institution of the Bretton Woods system that gives macroeconomic advice upholds a communicative relationship to its member states that emphasises the growth imperative following the existing orthodoxies.

Finally, what about states? Culturally and socially, their political management apparatuses have become aligned to serve the economic rationale; and more pragmatically, most of the physical infrastructure and contemporary societal systems that states care about demand the use of fossil fuels. But post-modernity has challenged Weber's (1919) modern state as the human community that (successfully) and simply "claims legitimate monopoly over the means of coercion in a given territorial area". Through economic globalisation; shaping and fragmentation of cultural identities (Rosanvallon 2006); and questions about physical constraints such as climate change and resource scarcity, territorial states under the Westphalian state-system are now under increasing pressure to find ways to re-organise the material chains they employ. In the acknowledgment of ecological thresholds, governments face a triple-faceted dilemma in re-thinking how to simultaneously "augment and secure the greatness of the state" and improve "the happiness of its subjects" (Burchell 1991, 122) while taking into account the changing circumstances. Nevertheless, the health of the national economy and government budget remain the key bottom-lines of the state decision-making machinery under the modernistic foundation of a state.

Some see that the commitments of states to various environmental agreements suggest that in theory, economic agents, individuals and institutions do have a preference for development that is environmentally sustainable (Hueting 2013). Then again, it needs to be remembered that on a national level, purely rational economic or environmental interests do not shape the choices of individual countries. To give an example, whereas Germany that may be assumed to have integrated SDIs into its political system, this may partially be due to the fact that the country is a parliamentary democracy with environmental ideology firmly rooted in the national political culture; Poland which depends 95% on coal in terms of energy consumption, considers that energy reliance on its neighbouring countries Germany and Russia is difficult due to historical reasons (Helm 2011). The traditional state identity (Schmidt 2008, 307) employs tacit change resistance towards low-carbon visions and sustainability targets because such ideas were not embedded in the original vision of state politics and political science – or even statistics.

Hauser (1973, 68) reminds that historically, "statistics were state-istics and statisticians once statists". In German, *Statistik* refers to the descriptions of the State, *Staat*; and in English, William Petty translated statistics into political arithmetic in the 17th century (Pasquino 1991) and for Petty's follower Charles Davenant, political arithmetic signified the "Art of Reasoning by Figures, upon Things relating to Government" (Davenant 1698, 2). In the 1800s, man began to increasingly think numerically (Hacking 1999, Burchell et al. 1991) with the improvement of health statistics and the likes of Charles Babbage in the UK demanding for books of numerical constants on the country's population. With the birth of European nation-states, statistical offices institutionalised to the state bureaucracy (Hacking 1990) and political arithmetic became an important tool for the state in the calculus of its power in the colonial and imperial era (Hacking 1999). Political arithmetic consequently transformed into political economy (Foucault 1966), which in the 20th century diverged into the sub-disciplines of political science, statistics, and economics, with the latter in particular taking form in mathematical expressions (Fox 2009). Gradually, the state had learned to use statistics to exercise power. To test the postulates of discursive institutionalism and the possibility of ideational change, this would suggest that not only states, but statistical offices and statisticians themselves should propose for the employment of new measurement techniques.

The fact that institutions follow theoretical developments closely in a sense proves what the theory of discursive institutionalism (Schmidt 2008) attempts to show: that ideas and the spreading of knowledge *from* epistemic communities (Haas 1992) can influence institutions. In contrast,

institutions and discourses they support also have influence, especially the states as the legitimate and sovereign actors of the international system, in shaping what discourses become dominant. Constructivist institutionalists who align closely with DI have heralded institutions as 'cognitive filters' (Hay 2006, 65), and for these reasons, the information they provide the decision-makers can be considered influential. However, a more critical view would note the role of people as actors within these institutions who in their respective capacities are able either to mould or maintain the institutions. In our case, it does not seem that the older theories of institutionalism were without explanatory power, on the contrary. Judging by the reactions of many institutions vis-à-vis the challenge of recognising ecological limits it seems as if many institutions suffer from cognitive dissonance: while these institutions have become aware of the constraints of carbon constraints; their policies have not necessarily adjusted accordingly. The state and intergovernmental institutions in particular seem bound by their history, culture and strategic reasoning well bound by their history, culture and strategies as the 'three new institutionalisms' teach us – or as the first institutionalist studies found – their initial rules and norms of these institutions. While these institutions may be assessed to have recognised environmental constraints, but the strategies towards reaction have varied, partly on the basis of the original mission of these institutions. Ideas also likely penetrate certain institutional layers more easily than others.

6. Complexity, rationality, material flows and energy

In the previous chapters, I have argued that the notion of sustainable development (H_1); theoretical advancements in science (H_2); as well as institutional interests (H_3) *all* influence contemporary perceptions about what is portrayed as 'sustainable' and consequently how it is measured. Finally, I will argue that while all of the SDIs efforts may reflect aspirations of SDIs as a technology of global governance (Davis et al. 2011; see also: Bäckstrand and Lövbrand 2007, 126), it is likely that different framings and rationales shape measurement techniques may in turn influence the way decision-makers adapt to problems (H_4) .

Thus, this concluding chapter will elaborate why despite the certain merits of the notion of 'sustainable development', the concept in itself needs to be contextualised and also alternative viewpoints can contextualise the decision-making process of states anew. Instead of macroeconomic theory in which ecological concerns are seen as *externalities*, the study suggests the possibility of political decision-making to be framed from a systemic viewpoint of ecological constraints and resource efficiency in which economic processes are *internalised* and dealt with appropriate political strategies. I will also argue that relativism is not an option and instead a hierarchical relationship between the different dimensions is more appropriate. To begin with, sociologists of science and philosophers are able to explain us why rationality as such is a controversial concept and in spite of ecological concerns, the numbers game has already managed to mislead decision-makers. After this, energy and material consumption as the drivers of ecological pressures are sought as a more 'appropriate' framing to illustrate a contemporary disconnect between the SD theory, economic logic and resource use. A new mathematical logic, or political arithmetic, as the seventeenth century political economists coined it, should be examined. And perhaps more attention should consider the well-being-energy nexus.

6.1 Rationality and accounting as problem-solving tools

"What is this society in which a written, printed, mathematical form has greater credence, in case of doubt, than anything else: common sense, the senses other than vision, political authority, tradition or even the Scriptures?

(Latour 1986, 26)

For many, the extreme diversity of "things" in the world has made it difficult for people to consider that science itself could ever constitute a single, unified project (e.g. Dupré 1993; Kuhn 1962) that

proceeds towards any objective truth. Such mechanistic positions, Dupré deems (1993), are not only deterministic, but essentialist and reductionist as well. As expressed by 20th century statistician William Deming, "the most important things cannot be measured". Of course, in a sense, they are right. After all, that is what post-positivism has argued all this time – that there is no 'objectivity'.

Haas (1992) emphasises how difficult in a globalised world it is for policy-makers to comprehend the linkages of interconnected problems. Let us only consider how Wall Street traders managed to trigger the collapse of the housing market under limited regulation; or how difficult it was for European politicians to understand the complex terminology of the so-called 'bailout packages' of the EU countries under economic difficulties post-economic crisis. Amidst a data revolution of today's information society, in which we are confined and perplexed with ever-increasing complexity, but nevertheless want to find moral answers to problems, this seems like a hopeless situation – there seem to be too many factors to make sense of. It is not surprising, then, that the measurement efforts towards sustainable development have not been spared from this critique. A typical critique against SDIs is that because of subjective preferences with regard to weighing, SDIs lose their credibility. Cynical sceptics in a postmodern spirit would argue that anything can be measured, which is why relativity simply makes measurement efforts redundant. As Ijiri and Jaedicke (1966; cited in Porter 1992) emphasise, accounting of any kind is a measurement system that is "plagued by the existence of alternative measurement methods".

I will, however, argue against such a stance and deem it unsustainable. One reason why I find this problematic regards an observation the National Research Council's Board on Sustainable Development in the U.S. made, expressing a similar frustration some years after the Rio Earth Summit in 1992. They stated that a lack of agreement on "what to develop, what to sustain, and for how long" has "hindered" the effectiveness of SDIs both politically and scientifically (NRC 1999, 243). And their observations do not end here. They state that while the root cause of disagreements about current measurement techniques *is* the ambivalent definition of sustainable development; "because no single set of indicators has satisfied all sides of the debate, this has hindered the further collection of data" (ibid. 239). Ironically, it seems that a post-positivist attitude *combined* with relativism may politically lead to a poorer outcome than a belief in positivist objectivity: indeed, no decision at all *is* often worse than a poor decision. The relieving fact, though, is that the history of science is full of examples where rationalities run counter to one another and encounter logical inconsistencies (Laudan 1977). Therefore, I argue in favour of the next best choice, which

according to Laudan (ibid., 122) is the employment of rationality, which at best can at least enable "a taxonomy to identify certain variables in scientific controversies".

Laudan (1977, 122-128) considers problem-solving the single most general objective of science, and rationality then, in theory, if built upon high standards could enable the build-up of theories that may be considered closer approximations to the truth than their predecessors (even if their distance to the truth may not be determined). Reality, in this picture, is seen as an ongoing effort to create order and make retrospective sense of what occurs (Weick 1993, 635). Weick (1993, 635) talks of contextualisation, situational assessment and sense-making when people try and make things rationally accountable to them and others. Looking at accounting in a historical perspective, Hacking (1990, 108–110) suggests that the measurements of Belgian statistician Quetelet in the mid-1800s initiated a transformation where statistics as descriptions about human populations actually began to remind the laws of nature and society – something Hacking holds as a crucial step in "the taming of chance". In terms of problem-solving, then, it is inevitable that rules most often must be based on some claim to rationality and as they shape theories, they are also bound into time and culture, and researchers have little choice but to make judgments on their present understanding (Laudan 1977, 129-130). Like the GDP, the SD conceptualisation chose to omit certain issues in the expense of others (Khosla 1987; Sunkel 1987; cited in Lélé 1991); and so have more recently other indicators such as the HDI and the MDGs.

Carrier (2004, 291) explains beautifully that "we understand a phenomenon only when we are able to embed it in a nomological framework, and we grasp a causal relationship when we can account for the process leading from the cause to the effect". Order was also essential in the Classical Age, where the Leibnizian project attempted to establish a system of signs, believing in complete enumeration, assigning each point with a necessary connection with the next (Foucault 1966, 61-69). With the aid of statistical techniques, the task of statisticians can be argued to make sense of complexity in order to provide relevant information to decision-makers who are responsible for the implementation of public policy and decision-making. Rationality needs not only to be understood as the possibilities of acting to maximise personal utilities; but as a function of cost-benefit analysis; believing in propositions that one has sufficient grounds to believe to be true; or merely a process of making statements that can be refuted (Laudan 1977, 121-122). This encapsulates why rationality can be understood as 'objectivity' based on certain conditions, and a technique of bureaucracy. Furthermore, this is why numbers as objects succeed well in capturing the eye, but almost always demand qualitative assessment.

Ultimately, rules are often ultimately based on some claim to rationality (Porter 1992, 640), and this is what accounting does, quite simply. Accounting constructs objectivity within a scientific field in the shape of scientific realism (Porter 1992), and reinforces internal coherence within that field or system. Objectivity as such, is a 'technology of distance' (Moffatt 2008; Porter 1992). Having now adapted to the thinking about rationality, or the taming of chance – like Hacking puts it, it would seem fit that all we need is a project worth engaging in. After all, also Foucault (1982, 779-780) preferred to analyse rationalities in particular fields.

In the last part of this paper what I aim to do is to recognise these certain variables. After all in cognitive psychology (Kahneman 2011; Tversky and Kahneman 1981) it is known that simply altering the way a problem is represented can shape the judgment and evaluation about it. Furthermore, due to limited cognitive abilities people struggle to "think statistically" (Kahneman 2011). Of course what needs to be reminded is that even in this process, some information inevitably is excluded. Like behavioural economists note, we live with 'bounded rationalities' (Simon 2000, 1991, 1955; Gigerenzer and Selten 2002) and in seemingly rational decision-making, only a limited amount of information is actually available. It has been argued that looking at climate change dilemma in isolation may distract attention from humanity's overall resource consumption as the root cause of most ecological pressures (Galli et al. 2012). I will argue that in a sense the same could be said about the theory of sustainable development. Elsewhere, a theory of 'new political economy' (Gamble 1995) has been sought. I attempt to turn the attention towards a new approach by re-framing the question of sustainability and well-being away from its superficial economic context to suggest that sometimes, policy-makers may simply be looking at the right issues from the wrong places.

6.2 Re-framing the welfare debate: material and energy consumption

Direct material consumption (DMC), a measure of the total amount of resources used or the extraction of materials, has increased fast. In 2005, the global material extraction reached an estimated 59 billion tons per year (Krausmann et al. 2009), which is an eight-fold increase from the figures in 1900. Using material flow accounting and analysis (MFA), Behrens et al. (2007), who suggest that their study was the first to quantify the material basis of the global economy, found a 33% increase in the extraction of fossil fuels, metals, industrial and construction minerals and biomass only between 1980 and 2002. In contrast material intensity, that is, the resource extraction per unit of GDP, only improved 25% (ibid.). This implies that in terms of material use, due to

technology effects there has been relative gains, but in absolute terms the human pressure on environment has heavily increased. The social or industrial metabolic rate, that is the amount of materials and energy used per capita and year doubled in the 20th century (Krausmann et al. 2009). This is known because many countries adopted annual accounting and reporting schemes in the 19th century (ibid.)

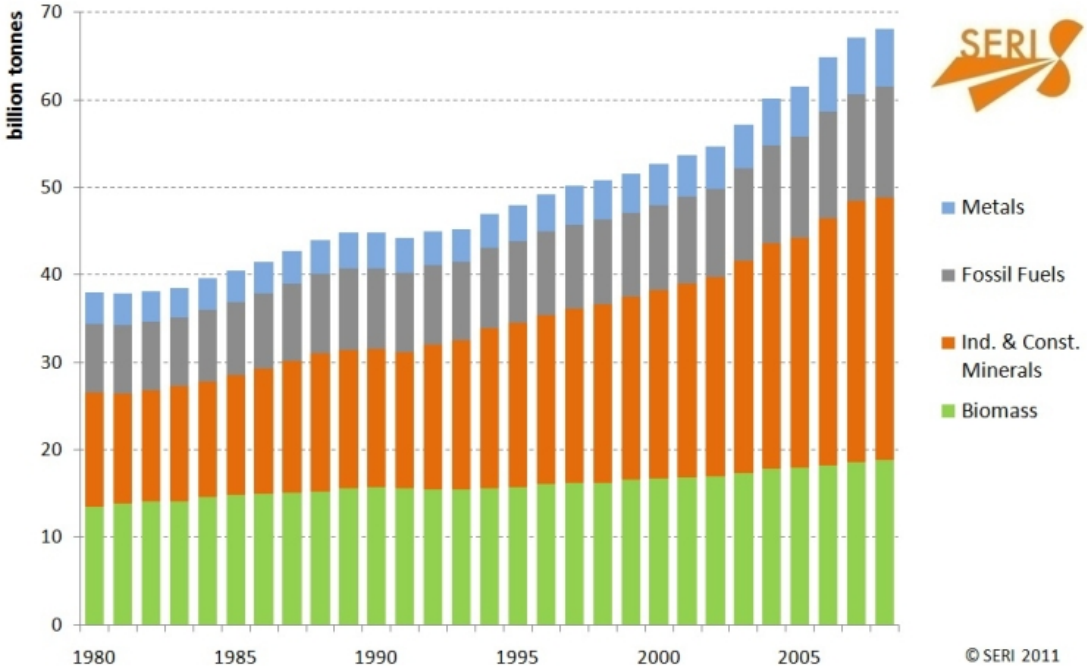

Image 9: Between 1990 and 2008, global resource extraction grew from 38 billion tonnes to around 68 billion tonnes. Projections suggest a possible annual figure of 100 billion tonnes by 2030. Global resource extraction by material category 1980-2008. (Source: Material Flows 2012)

Quite simply, in order for the global economy to grow, human societies drive environmental change with the inflow of materials and energy and cause corresponding outflows of emissions and waste *(Image 9)*. Of course, there is limited knowledge about the thresholds of metals and minerals in a global society whose economies are highly reliant on non-renewable materials. Resource demand is almost unforeseeable, and if the likes of China, India and Brazil continue to drive global economic growth and the projected population growth of 30–40% until 2050 materialises, there will be a further sharp rise in global material extraction (Krausmann et al. 2009; see also: Moyo 2012). Today, non-renewable resources account for more than 70% of total material use and their share continues to increase. Between 1945 and 1973, per-capita use of materials increased by more than 50%, and out of this amount, the increase in the use of non-renewable minerals was 340% (Krausmann et al. 2009). Whereas pre-industrial economies typically relied in biomass as the

primary material sources, between 1900 and 2005, the extraction of construction materials had grown by a factor of 34 (ibid.)[76]. This also increases land pressure, and the amount of materials used per unit of global land area and year has increased from 0.5 t/ha/yr in 1900 to currently more than 4.5 t/ha/yr (ibid., 2703).

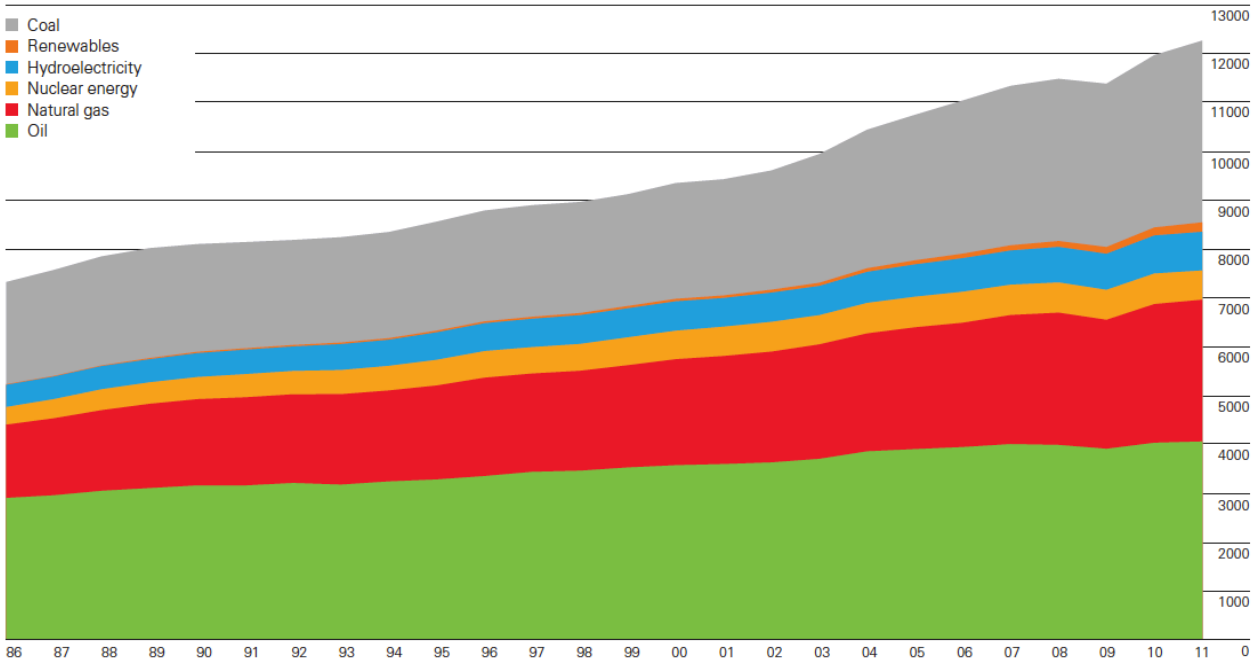

Image 10: World energy consumption (million tonnes oil equivalent) (Source: BP 2012, 42)

Another way to frame this case is to view the increases in energy demand *(Image 10)*. In 2011, about 87 % of global energy was produced with fossil fuels (BP 2012b), and energy represents about 65% of anthropogenic GHGs (IEA 2011a). Energy is essential to socio-economic development because energy is highly correlated with the economic system (Chiou-Wei, Chen, and Zhu 2008; Gautier 2008, 96; Lee and Chang 2007). Most major economies are highly dependent on fossil-based energy and the import of fossil fuels with their systems and infrastructure built according to the incentives of modernisation (IPCC-SRREN 2012; Peters et al. 2011): in 2009, 43% of global CO_2 emissions were coal-based, 37% resulted from oil and gas accounted for 20% (IEA 2011a). Out of global energy consumption, oil accounts for 33.1% and in 2011 coal reached the highest figure since 1969 at 30.3% as well as increasing carbon emissions (BP 2012b). In the global energy production mix, the share of renewable energies today is minimal. Depending what energy

[76] Construction materials now account for 22.9 tons; biomass for 19.1 tons, fossil energy carriers (coal, petroleum, natural gas) for 11.8 tons; metal ores (tailings) for 3.5 tons, industrial minerals for 1.2 tons and metal ores (metal content) for 1.0 ton (Krausmann et al. 2009)

methodologies are included, estimates of the share of RE vary from 2.1 % (BP2012b) to 12.9% (IPCC-SRREN 2011, 9)[77].

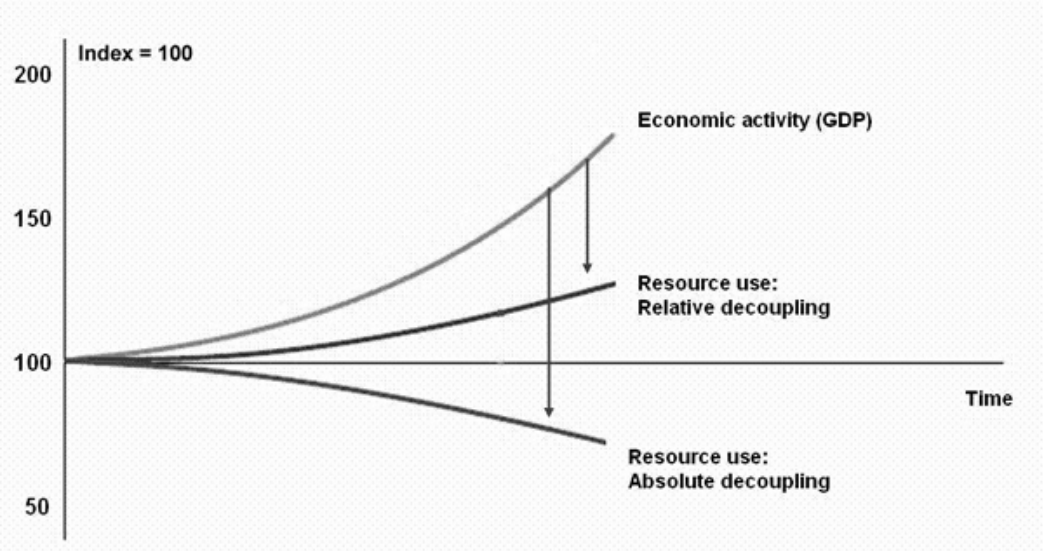

Image 11: Absolute and relative decoupling: resource use and GDP (Source: Raworth 2012b)

A classic measure to estimate the impact of human societies has been the Ehrlich and Holdren (1974, 1971) equation[78]. Jackson (2009) has adapted this equation to calculate the relationship of our contemporary societies with climate change to find that continuous economic growth and population growth have lead to a surge of greenhouse gases, because only relative technological gains have been attained (Jackson 2009, 77-82). Historically, in the relationship between energy consumption and economic growth, only efficiency gains, *relative decoupling*, have been achieved, even if *absolute decoupling* of economic growth from environmental resource consumption or climate change emissions is needed (*Image 11*)[79]. The 20th century saw increased efficiencies thanks to technological improvements, but not falling consumption. This issue is further

[77] In the 2.1% figure, BP includes biofuels. An increasing production of biofuels has been proven controversial due to loss of forest coverage that in turn is a source of climate emissions. The IPCC-SRREN report uses a less strict calculation technique to reach a 12.9% figure

[78] I = P * A * T, where,
environmental impact (I) is the outcome of population growth (P); consumption (which is typically expressed as a GDP per capita) (A); and the technology rate (T), which determines the efficiency of the consumption of resources
Economists typically assume production and consumption to follow each other rather closely (Jackson 2009)

[79] Kraussmann et al. (2009) suggest that it is impossible to reconcile economic growth with environmental sustainability. Hueting and Reijnders (2004) exemplify the decoupling dilemma with a list of six theoretical conditions, which would need to be met in order to combine growth of production and consumption with the restoration and maintenance of environmental quality. Technologies would need to be (*i*) sufficiently clean, (*ii*) not deplete renewable natural resources, (*iii*) find substitutes for non-renewable resources, (*iv*) leave the soil intact, (*v*) leave enough space for the survival of plant and animal species and (*vi*) be cheaper in real terms than current available technologies, because if they are more expensive in real terms, growth will be checked. Hueting and Reijnders (ibid.) conclude that while such a combination is theoretically possible, it is scarcely plausible, considering the spectrum of all human activities.

undermined by the *rebound effect*, or the Jevons paradox, which suggests that efficiency savings in one area of economic activity will likely lead to those savings merely being re-invested into activities in another area (Haberl et al. 2011; Gjoksi and Sedlacko 2011, 7; Krausmann et al. 2009)[80].

Energy consumption based on non-renewable resources increases continuously. Still two hundred years ago in 1820, 94% of world energy consumption resulted from the use of organic materials (Maddison 2005a, 15). In contrast in 2001, mineral fuels such as petroleum, coal and natural gas accounted for 89% out of the total use (ibid.)[81]. During this period between 1820 and 2001, the world saw an eight-fold rise in per capita energy use. Between 1900 and 1970 alone, overall consumption of fossil fuels grew tenfold (Newell and Paterson 2010, 13-14). But looking at the more recent statistics, between 1980 and 2008 the total primary energy consumption almost doubled from 283 to 490 quadrillion Btu[82] (US EIA 2012). In 2011, world primary energy consumption grew by 2.5%, and China accounted for 71% of this growth (ibid.). By 2035, for energy globally, IEA projects a 75% growth in demand, and the US EIA a 53% increase in consumption (US EIA 2011). In addition, BP suggests that in 2030, 80% of global energy production will remain with fossil fuels, adding that the 2011 Fukushima event will hold down the enthusiasm to use nuclear energy. IEA (2011b) provides similar projections, suggesting that the percentage of fossil fuels will only change from 81% in 2010 to 75% by 2035[83]. China plans for 1 000GW of new coal between 2011 and 2030 (Helm 2011)[84]. Energy intensity measures the energy efficiency of a national economy, expressed as the ratio of total energy use to GDP (mJ per USD) suggests that in industrialised countries, even if technology gains improve energy intensity, energy use continues to increase.

Although the original environmental arguments were formulated against the 'oil peak' and 'the limits of growth', the recent resource discoveries now suggest that there are rather considerable amounts of fossil fuel reserves to be found. From a sustainability perspective, the climate argument

[80] The Jevons Paradox (1865) is one of the most influential and fundamental critiques of economic growth. William Jevons noted that even if the efficiency of production increases, the production volumes will increase even more.
[81] Oil spurred the intensive industrial revolution. In 1859, two thousand barrels of oil was produced. In 1874, the annual figure had risen to 11 million barrels. Today, the world produces 74 million barrels of crude oil *per day* (Indexmundi 2013; US EIA 2013; Newell and Paterson 2010; Hobsbawn 1975)
[82] Btu = British thermal unit. The unit is used to describe the energy content (heat value) of fuels (1 Btu = 1 054-1 060 kilojoules)
[83] Variations in calculations depend on considerations and technique. Peat is typically considered a non-renewable resource. In some calculations, biofuels are not considered renewables
[84] According to BP (2012b) prediction to 2030, still during 2020-2030, coal demand grows 0.5% p.a., because of China (67% of growth) and India (33%)

is now rather pointing towards 'the limits of use'. While it does seem there is an increased difficulty to discover conventional oil (Gautier 2008, 84–85; IEA 2011b), unconventional oil reserves such as oil shales and tar sands may provide unseen resources of fossil fuels (Helm 2011). Of course, to some extent, the sufficiency of global resources for both energy production and as materials is difficult to determine because new findings naturally increase this figure. The R/P-ratio used by US Geological Survey, measures the sufficiency of currently known reserves to production, and according to BP (2012b), in 2012 current coal reserves were sufficient for 112 years of global production, oil reserves for 54.2 years; and natural gas reserves for 63.6 years. Oil remains a cheap energy option, highly demanded by both industrialised countries and increasingly by emerging economies. Technical progress has enabled the extraction of energy from the input of natural resources (Malanima 2010). The recent push to explore not only conventional oil from easily exploitable oil fields, and to seek unconventional oil resources, is due to rising demand, lost capacity, and possible with further advances in drilling technologies (BP 2012a, 27; Gautier 2008; IEA 2011b; US EIA 2011)[85].

New oil discoveries may provide a substitute effect and postpone energy companies' investments into non-emitting energy technologies. All these figures suggest that with regard to the climate change concern, there remains fuel to consume beyond any safe limits of allowed carbon to limit global warming (McKibben 2012). Economically, as McKibben (2012) explains, the fossil-fuel economy globally already plans to burn an amount 2 795Gt of carbon, a figure five times higher than the allowed amount to stay within +2°C. These calculations were recently echoed by the new IPCC AR5 (2013) report. One obstacle in the promotion of renewable energies are the fossil fuel price and production subsidies, which globally exceeded USD 650 billion in 2008 (IEA et al. 2010; UNEP 2011). During Rio+20 in 2012, a civil society campaign called to "End Fossil Fuel Subsidies", but while this call was acknowledged in the Rio+20 Final Outcome Document, the wording[86] did not significantly change international positions from the previous commitments such as the G20 statement in Pittsburgh in 2009.

Helm (2011, 85–86, 89–90) provides an excellent summary of the market dilemma. If increasing coal demand, increase in Middle East production, the cheap and increased use of unconventional gas (IEA 2011b), potential great quantity of unconventional oil in Brazil, Canada and the U.S. (BP

[86] Paragraph 126 supports "the eventual phase out of market distorting and environmentally harmful subsidies". Paragraph 70 discusses the issues of sustainable and renewable energy.

2012a, 27), or even access to Arctic are combined; supply will keep fossil prices low and renewable and nuclear prices high; indicating an abundance of fossil fuels beyond the limits of the climate to tolerate. Even with substitution to unconventional natural gas, the cleanest of fossil fuels, global warming will exceed +2°C (IEA 2011b, 4) Helm (2011, 86) advocates a rapid shift with public targets and associated investments for non-fossil fuels, if the "energy Armageddon" is the case.

In the industrial and post-industrial era, renewable energy technologies have occupied a very low proportion of the national energy mix, with typical figures far below 10 per cent[87]. Examples extend across the globe from Argentina (7.0%), Australia (5.6%), U.S. (5.4%) and Ireland (4.5%) to Japan (3.3%), not forgetting Arab countries that are practically 100% dependent on fossil energy. Out of primary energy supply, only few countries have a share of renewables worth mentioning (Iceland 84.2%; Costa Rica 55.3%; Brazil 45.8%; Norway 43.3%; Latvia 37.1%; Uruguay 37.1%; Sweden 34.8%; Finland 23.8%) (HDR 2013a). In 2011, though, a record figure of USD 257 billion was invested in renewable energy that amounted for a 17% increase from the previous year (REN21 2012) with the top five countries being China, U.S., Germany, Italy and India (IPCC-SRREN 2011). However, in a recent IPCC study, half of the energy scenarios give RE a share in primary energy at maximum of 27% by 2050 (ibid., 794)[88]. Such deployment rate would leave no chance of climate change mitigation. Therefore, although the environmental movement has already deemed nuclear energy unfit once; some (e.g. Lynas 2013, Caldeira et al. 2013) are now promoting it as the least worst option to the climate dilemma. Whichever the case, it seems that an overhaul of the global energy system is the only option to mitigate climate change, even if in short-term it would prove extremely costly. This overhaul would require public support and investment nationally and internationally (IEA 2011b) in areas such as new production units and large-scale transmission networks.

I am now approaching the conclusion of this re-framing exercise in which energy and material consumption have enjoyed the centre stage. The boldest have suggested that a new arithmetic should actually look at energy as the new bottom-line measurement for all commodities, and even to replace money as the unit of accounting, measuring and exchange. After all, energy can be traded between countries (Schilgen 2013; Hille 1997). Energy measurement techniques suggest that

[87] Renewable energies (RE) that typically are associated with sustainable development count at least wind power, direct solar power including solar photovoltaics (PV) and concentrating solar power (CSP), geothermal heat and power, hydropower, ocean energy and bioenergy (IPCC-SRREN 2012).
[88] In the IPCC-SRREN Report, only two out of 164 scenarios predict a RE share of 77% in 2050

environmental space could be defined in terms of (primary) energy consumption as a single aggregate, in joule (Hille 1997). There are a few courageous approaches to this.

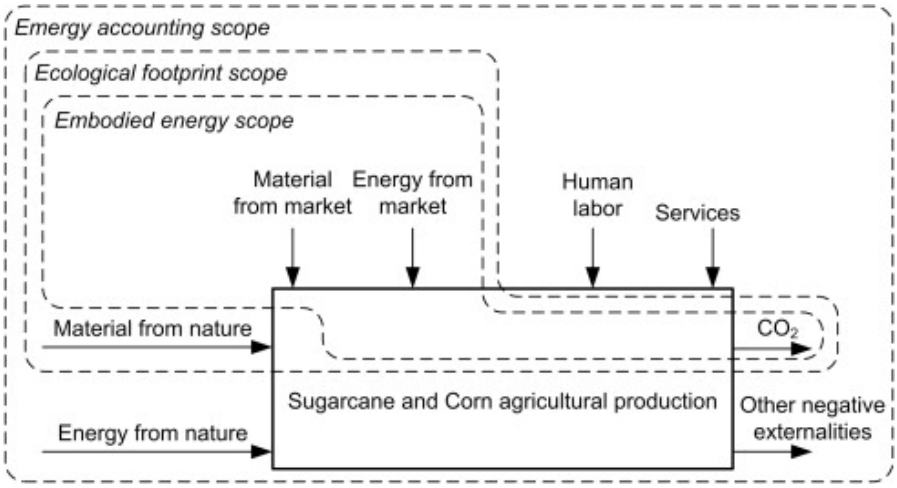

Image 12: Emergy accounting (Agostinho and Pereira 2013)

Emergy accounting (Agostinho and Pereira 2013; Schilgen 2013; Mayer 2008) would allow the definition of the size of an economy based on the amount of energy units to create the output of goods and services (similarly as the GDP accounts for the total production in the neoclassical economic theory) *(Image 12)*. Agostinho and Pereira (2013) argue that an advantage even compared to the ecological footprint (EF), which calculates the embodied energy only in the material and services provided by the human economy, is that emergy accounting also includes the natural resources required to make them. Also *exergy accounting* has been suggested (Sciubba 2013, Vihervaara 2013) as a measure of the primary (exergy) resources embodied in a material or immaterial product[89]. Exergy is the embodied energy in a natural resource over time and like energy measured in joule. Schilgen (2013) argues that energy accounting would redefine the quantity theory as a relation where a given amount of money would represent a given and real based physically measurable amount of commodities, goods and services. A shift towards energy accounts would not perhaps be as difficult to implement as one might first think. Many countries already constructed energy accounts with the dramatic oil price increases of the 1970s (Lange 2003, 6). It seems that these ideas are still very recent and perhaps quite theoretical, and thus little can be said about their viability. What is interesting, though, is in how they make one pay attention to an area that has typically been beyond the scope of economic considerations.

[89] Sciubba (2013) suggests an indicator called the extended exergy cost, eeC.

I have attempted to argue why energy, material consumption and infrastructure matter, and that without understanding them, the measurement of sustainable development remains disconnected from the material basis of well-being. According to estimates, US$350 trillion globally will be spent on urban infrastructure and usage over the next 30 years, and if these investment follow "business as usual", these investments *alone* will appropriate more than half of humanity's carbon budget allocated for the whole of next 90 years (WWF 2010b; Höhne and Moltmann, 2009; cited in WWF 2012). I argue that in the contemporary systemic conceptualisations, the extraction of materials and energy consumption as the basis of the material economy and human societies seem like the "elephant in the room", or the ignored subjects of a systems analysis.

6.3 Is there a governmentality effect?

Having discussed the issue of energy, this paper ends with a discussion of the issue about the governance of sustainable development. This paper has moved from the original postulate of the theory of sustainable development to assess current measurement approaches to well-being and ecology. It has been demonstrated that there is a numerous amount of different types of indicators, and this last chapter has insofar attempted to demonstrate what the physical basis of human actions on the ecology, something that most SDIs have not discussed. The volume of aggregate energy and material flows at least illustrates the magnitude of resource consumption.

In the beginning, it was suggested that indicators may be considered as a technology of global governance (Davis et al. 2011). However, while this study has found considerable evidence of the power of numbers, in general, and also the benefits and need of solid rankings based on ecological performance, it seems also fair to conceive that not all numbers are perceived or dealt with equal attention. After all, we "consume" many types of information (Knorr-Cetina 2010). Rather, the power of numbers as a technology of governance is expressed as a potential, and the strength of environmental and resource bottom-lines insofar has been considerably modest. Taylor and Buttel (1992, 408) write that moral and technocratic responses are alike attempts to influence politics. In this paper, we have used the SDI notion interchangeably to refer to different types of indicators that claim to measure sustainability, and evidently, a plurality of perspectives is found. However, sustainability indicators do not simply promote a particular kind of understanding of the human impact on the environment, but implicitly provide policy-messages over proper action (Lenzen et al. 2007; Cobb and Rixford 1998). Therefore, those constructing reporting methodologies are never operating in a value-free zone, but are using the methodology to influence people and effect change, hoping that "right action" will follow. Theoretical, methodological and normative choices that

shape the construction of an indicator are an intrinsic part in the construction process and already value-laden actions (ibid.). Erkkilä and Piironen (2009, 131) remind that most important is that the indicator user or reader understands how and why the aggregation has been made, which aspects are lost, what is weighed and what less emphasised.

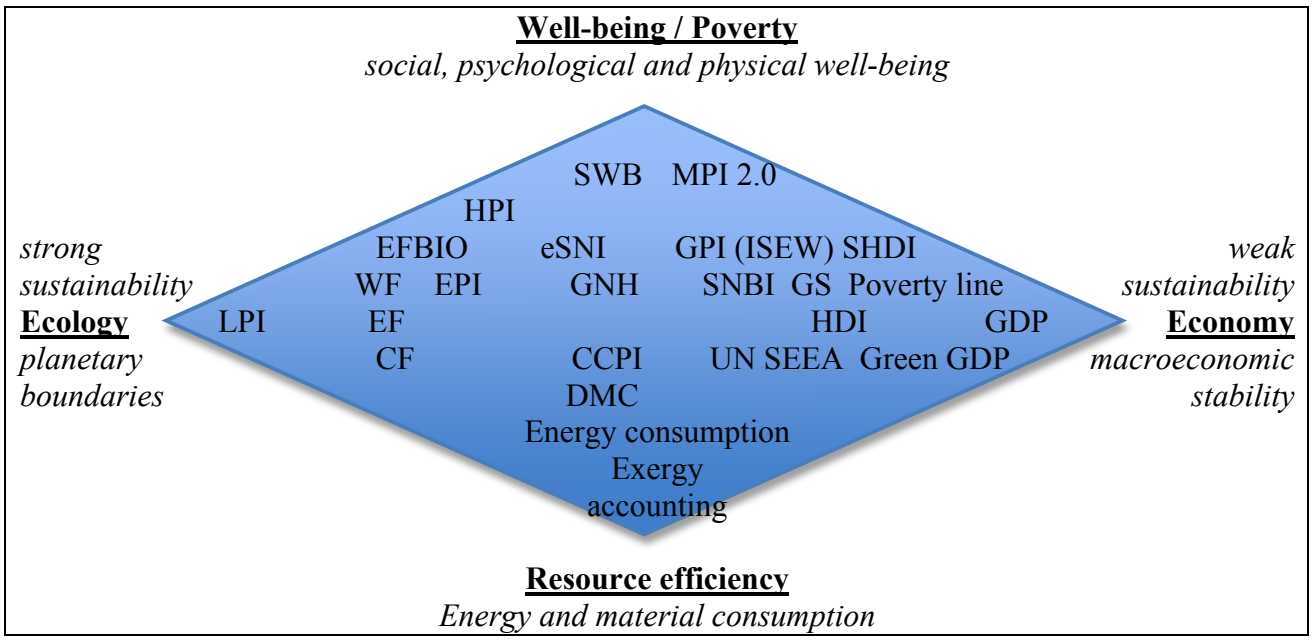

Table 4: Indicative matrix of selected indicators according to their theoretical assumptions.

I propose a following four-dimensional typology (*well-being or poverty; ecological considerations; resource efficiency, and economic considerations*) of the conceptual space, within which these SDIs operate and the worldviews or attention focus they represent. Conceptually, this is slightly different from, say, the Beyond GDP typology (see: page 32) that was earlier discussed. Rather than positioning indicators in ready-made "boxes" that near the SD theory, I advocate for a more dynamic conceptualisation. As these indicators have already been discussed in this paper, I will only illustrate a selected number of them briefly in the illustration above *(Table 4)*. Note that this illustration provides is indicative, not based on exact correlations.

One-dimensional indicators (energy-based accounting, level of greenhouse gases) explicitly set an ecology-based bottom-line to adhere to. Indicators that describe the human pressure on environment (footprint family, HPI) are also useful. Additive economic indicators such as GPI, ISEW, SNBI and eSNI attempt to incorporate a number of these externalities such as environmental and social costs into economic valuation. Well-being, development and poverty indicators (HDI, MPI 2.0) are able to describe how people are doing in a number of ways, or overall if they are satisfied with their life (SWB). The value of the GDP remains as an aggregate figure of the material economy even if does not appreciate biophysical constraints. Composite indicators can be problematic if they try to

combine more than one dimension, and there are also dashboards of sustainability (Moffatt 2008) that do not give instructions about prioritisation. The GNH represents an existing alternative that is employed in state-level public policy, and in turn, the CCPI represents and indicator that assesses the success of policies. Material consumption can reveal the overall burdening, even if it does not make thresholds visible.

As argued by Porter (1992) and Latour (1987), power is in institutional settings and networks. The UN SNA has existed since 1953 to push for the maximisation of growth and the aggregate economy based on material ingredients. And where UN SEEA was officially adopted in 2012, it remains a separate guidebook from the actual UN SNA, which seems slightly problematic. At least, it seems to re-create the intellectual gap between mainstream economists and environmental economists. Where Greenwich mean time (GMT) or the Coordinated Universal Time (UTC) is measured near London, United Kingdom set the international time standard; it is perhaps time to update the measurement techniques at the highest UN level and recommend countries to measure progress in a climate- and environmentally sustainable way (see also: Pinch and Swedberg 2008). However, in doing so countries must avoid the risks and flaws of choosing a *fallacious* SDI in those many alternatives that have already been provided. Increased visibility for other measurements beyond GDP would provide countries with alternative signposts when they are making their policy choices.

For a SDI could only succeed in becoming accepted as a universal standard that applies for all countries, it would need to be able to credibly operate regardless of national political, economic or cultural context – after all, this is what the GDP has achieved. As in all methodology related choices, they should be independent, based on the principles of science, not subject to politicisation such as pressure from countries or state bodies who are subject of this assessment exercise. For an indicator to become a 'centre of calculus', the indicator needs reliable institutional apparatus to support the measurement efforts. Today, the costs of distributing information are almost non-existent. This would rather support the views of biologists that have called for the better marketing of existing data (Knight et al. 2010). In terms of long-term impacts, consistency matters in order for an indicator to gain credibility amongst policy-makers. Lyytimäki et al. (2013) suggest that the long-term maintenance of existing communication platforms is easily neglected. Some indicators seem to have already fallen for this trap. Another evident challenge of SDIs, as with any international statistics, legislation or policy measures, is the differences between countries, even if standards assume them to perform similar tasks. Internationally, an illusion of green governmentality could suffer from *geographical bias*. In developing countries, national statistical

offices have fewer resources than their counterparts in the Western countries (Jerven 2013). Ndou (2004, 16-17) writes that while a "new economy" could be characterised by revolutionary changes in science and technology with information and knowledge key factors for economic competitiveness, developing countries have less ability to reap the benefits due to political, social and economic hindrances.

Over half of the world population lives now live in urban areas that are detached from the material basis of production. Traditionally, the human being shared a direct physical and cultural connection with nature thanks to certain visible feedback loops of his actions in the daily life. However, the postmodern agent, aware of pressing environmental concerns but creating invisible environmental impacts seems to demand new signals. Environmental impacts materialise both within and beyond the borders of a legally defined nation-state, which emphasises the need of choosing correct measurement techniques to set valid bottom-lines (Fiala 2008)[90]. This could help to re-establish the relationship with the nature. It may need a political deliberation and a high-level agreement to provide understanding for people, leading their practical life in their contextual social reality, dependant on the surrounding environment. Although we have not examined this consideration in detail, but our study does suggest that as heuristics, economic indicators are more closely aligned to political decision-making structures as well as our daily choices than social and environmental indicators or resource issues, even if people would also tend to value the latter two. This means that the latter need to be brought more centrally to the systems of political decision-making.

Even if a 'holy Grail' (Canoy and Lerais 2007) may be unattainable, I call this thinking process of learning with indicators a quest towards a 'new' political arithmetic. I would argue that when we are assessing how numbers work *for* sustainability, as it stands, only a limited potential of this power is employed. Important data gaps remain especially in the environmental dimension and need to be addressed. In some sense, some measurement techniques such as carbon footprint or ecological footprint have already pushed (at least industrialised) societies towards a more profound understanding of the incorporation of natural values into decision-making. There needs to be a close relationship between users and producers to make information relevant (Hauser 1973). Cobb and Rixford (1998, 29) add that manufacturing numbers alone is not enough, but in order to make substantive changes, one needs to reach the proximity of decision-makers.

[90] This may also be reflected with the earlier debate of GDP vs. GNP and whether to calculate economic output according to geographic location or ownership. While the impacts of economic activity in a certain geographic area (such as a state) extend beyond a country's border, material structures such as production units – even in a multinational company – are located in physical location(s).

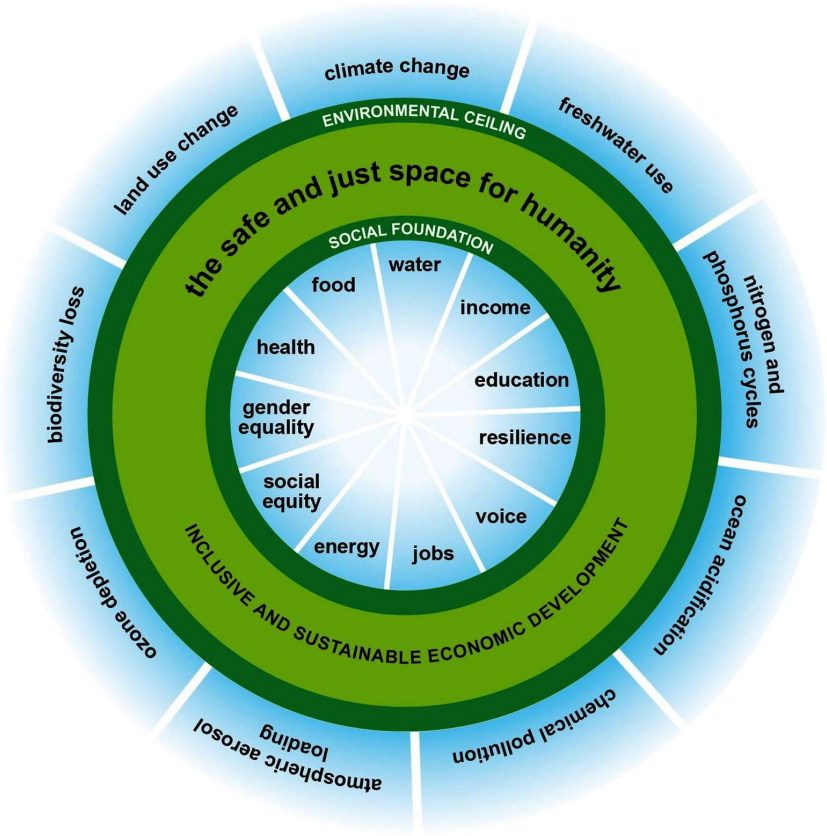

Image 13: A safe and just space for humanity between social and planetary boundaries (Source: Raworth 2012a)

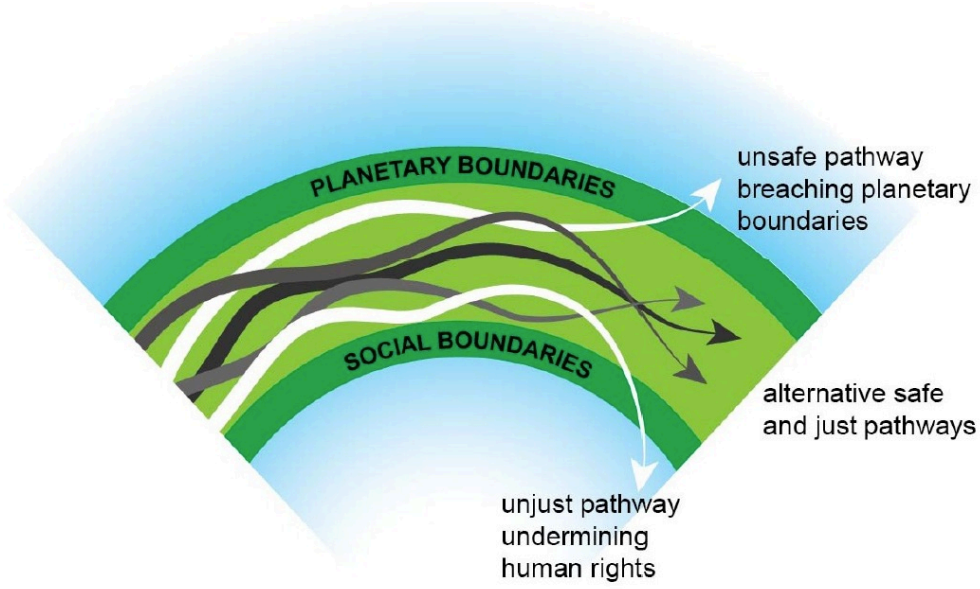

Image 14: Social and planetary boundaries (Source: Leach 2012)

The dilemma to merge the dimensions has created different types of conceptualisations (*Image 13, Image 14, see: previous page*). Raworth (2012a) has attempted to conceptualise 'a safe operating space for humanity'. Leach (2012) provides a complementary framing in her depiction of the desirable middle between two extremes where social boundaries determine the minimum acceptable threshold of living, and planetary boundaries make the upper threshold. In her definition of 'safe and just pathways', sustainability refers reminds of an Aristotelian golden mean.

"As I've said before, even if we were to do everything right, greenhouse gas emissions in Los Angeles, Beijing, Delhi, and Sydney would still melt the glacial lakes here in Bhutan to cause devastating floods in our river valleys. And since opening up to the world, and as you'll see even during your short stay here our people are no more immune than people elsewhere to the temptations of consumerism, materialism, automobile fetishism, rural-urban migration, and all the social ills those trends bring. We've learned the hard way that we can't be a GNH bubble in a GDP world and that we can't build a GNH society in one corner of the Himalayas surrounded by a world obsessed with accumulation of material wealth at all costs."

(Prime Minister of Bhutan, Jigmi Y. Thinley, Opening address
The 1st meeting of International Expert Working Group for the New Development Paradigm,
Thimphu, Bhutan, January 30, 2013)

So how to illustrate this dilemma? Both production- and consumption-based figures can be inadequate. However, international legal frameworks such as the Kyoto Protocol have tended to hold producers, not final consumers responsible (Galli et al. 2012). In the case of the European Union, production-based figures would falsely suggest that a decoupling effect has been achieved, even if Western consumers are knowingly dependent both on products manufactured in China and elsewhere, and also vast amounts of energy is imported from outside the EU borders. Also emissions data to the IPCC is reported as contributions of producing industries located in a particular country and if consumer responsibility were to be assumed, exports would have to be subtracted from and imports added to national GHG inventories (Satterthwaite 2008; Lenzen et al. 2007). In terms of resource consumption, regions or countries that use little of their own natural capital but import from abroad are by intuition unsustainable, but surprisingly many statistics ignore this fact. Lenzen et al. (2007) suggest that although a number of studies highlight final consumption and affluence especially in the industrialised world as the main drivers for the level and growth of environmental pressure, the economic policies of market-driven economies have deliberately aimed to avoid interference with consumers' preferences.

Therefore, consumption-based approaches might also be needed. A recent paper by Barrett et al.

(2013) argues that without consumption-based approaches, territorial emissions cannot provide a complete picture of progress in regional and national emissions reduction. Consumption-based indicators struggle with the logic of global production chains. Australia, for instance, is the largest recipient of China's FDI and exports coal to China in order to meet China's resource demand. Because the coal is consumed in China, it does not show in the production-based country statistics of Australia. In the other extreme, full consumer responsibility perspective suggests that all impacts incurred during production belong to the consumer of products, and this method is assumed by the life-cycle assessment (LCA) technique (Lenzen et al. 2007). This does not mean that assuming consumption-based indicators would not be without consequences: blaming the looming environmental catastrophe on the consumers could have a significant impact on the world economy and a reconsideration of its structures. The development of shared responsibility accounting techniques has also been advocated (Satterthwaite 2008; Lenzen et al. 2007).

Instead of a blame game, the consumer in the downstream of the supply chain, the middlemen as well as the producers who use land and energy in the upstream would be held responsible for the increasing carbon emissions. Working for the latter proposal would evidently require certain common understanding between different parties from oil-exporting countries, manufacturing countries as well as industrialised countries with most of the affluent consumers in order to jointly assume the responsibility of doing the math. An interesting SDI could signify the dependence of industrialised economies on fossil resources, but perhaps as well of material extraction of developing countries that still remain as primary commodity exporters, something which many development scholars have for years advised them to move away from. This would perhaps also imply the need to look at indicators such as import/export ratios of energy and material resources. On the human well-being side, there is a need perhaps to consider psychological factors (Seligman 2002) and issues of social capital (Putnam 2001) more than has been the case under the GDP.

In all seriousness, Raworth (2012c) has demanded that all macroeconomics textbooks and their frameworks should introduce ecological limits, in order to make society re-consider its choices. A means of bridging the gap between the visible economic transactions and invisible social and ecological impacts as well as between disconnected spheres could be the type of education that connects theoretical concepts and real-life observations. After all, education and science policies (Latour 1987, 153-157) guide and prepare people for their professions. Business schools educate entrepreneurs; law schools make lawyers; while economics classes still base their teachings on neoclassical economics (Colander 2000) and disciplines such as economic and social history

undermine the component of ecology. If ecological constraints are not at the core of all human activity, it is difficult to see how they could be acknowledged. Too much trust in a single theory within a particular rationality of a selected discipline could generate too much beauty in the eye of the beholder in the expense of considerations beyond the worldview of the concerned. Latour (1987, 241-242) rejected the independency of theories from the objects they study.

Macrosociologists such as Weber and Foucault examined public philosophies as ideas that dominate the society and construct basic worldviews and underlying value systems (Schmidt 2008). Nationally (as well as regionally and locally), the only way for a SDI to reach visibility is for it to have high-level political commitment. Therefore, a headline figure should likely be championed by the Prime Minister and in this picture, the Cabinet line ministries would have oversight of the target in their respective sectoral ministries. Within state administration, a pragmatic challenge has been the fact that different policy-makers use different statistics sectorally; economists read economic graphs; health sector people read health figures. The Ministries of Environment, typically the ones responsible of the climate change issue in many countries are underdogs. In the UK, the Climate Change Act (2008) has attempted to overcome just this. Section 4 of the Act states that it is the duty of the Secretary of State to set a "carbon budget" and to ensure that the net UK carbon account for a budgetary period does not exceed the carbon budget. In short, genuine politico-legal commitment is needed – in all levels of society. Another emerging measure is the comparison of the available carbon budget of humanity against our socio-economic structures such as the amount of finance and economic investment "locked-in" (see also: IPCC 2013; McKibben 2012).

Amidst the global economic crisis, The Economist (2012) humorously asked whether shifting from the management of the GDP to happiness, would make politicians manage this dimension as poorly as they have done in managing the economy. Perhaps, but at least they would be forced to pay more attention. Different framings influence the interpretation of a problem and this is exactly where the governmentality effect is tested[91]. If alternative bottom-lines next to the aggregate output such as a carbon budget or an energy budget were calculated, and states would mutually sign into following these accounts, and they were institutionalised into the state apparatus, these might form a two-dimensional bottom-line where today the economic output defines a state's strategic behaviour. In

[91] In an interview to The Guardian (October 24, 2013), Christina Figueres, the UNFCCC executive secretary, states that carbon budgets are a good scientific exercise but using them for political decision-making is a challenge. "Politically it would be very difficult. I don't know who would hold the pen [in setting out allocations of future budgets]." (See: The Guardian 2013c). Earlier (May 30, 2013), an article written by Andrew Simms was published in The Guardian, titled pessimistically: "Why did the 400ppm carbon milestone cause barely a ripple?

spite of varying interests of different stakeholders, the adoption of a single standard could be possible – for there are always alternatives. On a state-level, Bhutan measures Gross National Happiness (GNH), providing one possible methodology set. Also, different countries have already made trial efforts towards the adoption of alternative bottom-lines. In the case of HDI, Sen (2000) thinks that "the idea of human development won because the world was ready for it". Raworth (2012a) reminds that although science attempts to give an objective description of the planet's biophysical reality, the setting of the boundaries of natural resource use is ultimately a normative decision based on perceptions of risk.

Conclusion

This study has explored the scientific and institutional assumptions and principles the indicators of sustainable development (SDIs) as a technology of global governance (Davis et al. 2011), complemented by a discussion about the role of statistical information in evidence-based policy making. The political science perspective has been employed to connect the debate of model-making to Hacking's work on social constructionism and the taming of chance by numbers, complemented with Latour's critique of economics, extending to the work of ecological economists to explore the interface of social and natural sciences with practical policy-making, which is shaped and constrained by institutions that as knowledge actors are important filters that shape our cognitive understanding.

The findings suggest that the most important question to ask is not merely whether the GDP should be superseded, but what measure to use as the *primary figure* to instruct policy-making. Also, the influence of framing has been extensively discussed in the context of 'planetary boundaries' and human development. To summarise, concerning the SDIs, out of different framings of sustainability, human pressure indicators and single-dimensional bottom-lines are the easiest to comprehend. Composite SDIs, in spite of their attractiveness, may take the policy-maker into muddled waters as (s)he will be unaware of the theoretical choices that frame the indicator because simply by changing the model construct, it is possible to achieve seemingly different results under a captivating umbrella label. Therefore, it seems important to scientifically agree on the rigour of the selected indicator to assure the legitimacy of models. Human pressure indicators are able to visualise what are the effects of human actions on the environment. If one-dimensional figures are used, there is clearly a need for some hierarchy. In this matter, ecological, social and cultural indicators should be prioritised because the ecology as well as well-being are affected by economic activity. With regard to climate change globally, the level of greenhouse gases and total energy consumption are illustrative figures that are easy to understand, especially when they are connected to the global warming projections. Out of the SDIs discussed in this paper, only the Bhutanese SDI explicitly seems to attempt to combine material, spiritual and ecological development in a single measurement effort. Also, it may be worth paying closer attention to subjective well-being and social capital more than was necessary in the era of modernisation. Resource-efficiency and energy consumption are something that most indicators have overlooked. New connections in the interlinkages of energy (and exergy) accounting, strengthening current institutions in the human-environment axis as well as making the ecological foundation of human development visible could

shed light upon areas that as it stands are not incorporated to the measurement processes of human action.

The focus of this study on the power of knowledge can be criticised from a lack of adequate legal focus – for international legal agreements tend to govern international relations. However, this paper will touch upon this issue as it shows how despite existing legal arrangements, global environmental governance is difficult (see also: UNEP 2012), and making new environmental agreements a struggle. Another valid criticism concerns a possible failure to avoid the traps of institutionalist paradigms that traditionally struggle to explain change. I have attempted to minimise this harm by the choice of using discursive institutionalism as the main explanatory theory, while also considering the explanatory force of other, more traditional institutionalist approaches. Certain sociologists of science (Howlett and Morgan 2010; see also: Morgan 2010) have studied how facts travel, and the examination of the science-policy-interface from the dissemination perspective would indeed be interesting, if impossible to be conducted here. Finally, it would be more than interesting to study the nuanced micro-level mechanisms of the employment of SDIs in a local or national context, or deeper examine the user perspective to the psychology of numbers, but for this purpose, I suggest political scientists to engage in ethnographic methods or jump into a mode of case studies or comparative analysis on a local, country- or regional basis; or go and study psychology. Finally, for those seeking answers, as a study about governance, this study cannot explain how change *for* sustainability occurs, and a researcher with such interests would do better in using organisational or management theories.

Broadly speaking, while economic equations and figures have become standardised around the formal economy, they have been separated from the physical and material basis. Back in the days, environmental limits were not relevant for the study of economics and while the imperatives of economics evolved, this knowledge basis continued to develop in isolation from the study of the material basis of the extraction. In 1890, not even once did Alfred Marshall's economics textbook mention the externalities of economic activity such as pollution or the need of environmental conservation; in Ricardian economics, land was studied as a factor of production; not from the viewpoint of land degradation; and yet today, the textbooks of macroeconomics or finance as technical instruments fail to connect with ecological constraints. Of course, the coupling of social considerations with technology and the economic laws has largely enabled human development. However, in doing do, they have ignored the ecological basis enabling this development. It feels as if in future, development, ecological and welfare economists should work together with neoclassical

economists, financial experts and other scholars in order to create an interdisciplinary understanding of the scientific basis of 'being': to re-establish this connection and provide new interesting ideas in order to emphasise the role of energy, physics and ecology in operational decision-making and as bottom-lines of material well-being. Also, perhaps in an ideal situation, publicly recognised scientific estimates about resource sufficiency were actively published to enable decision-makers to use the precautionary principle of environmental law to respect these thresholds and tipping points. As it stands, sustainability scholars alone only constitute a loosely unified intellectual grouping.

Schmidt (2008) suggests that "ideational change in science results from internal processes, when the Kuhnian paradigm expires because it has exhausted its explanatory potential, ideational change in social science and society results also from external processes and events that create a receptive environment for new ideas". The SDIs can be argued to have been born into a continuum of a politico-administrative rationale, with its historical roots in the 16th century (Hacking 1990), born out of a necessity to govern. There are evident tensions notable, and different institutions take different views into SDIs. Rather than a mere technocratic tool, SDIs are a compromise of interests and ideologies, posing themselves against the intellectual heritage of Enlightenment, Western political philosophy, the tradition of capitalist critique and their modern offspring: political economy, economics and neoliberalism (Mirowski 2009, Fukuda-Parr 2003, 304). Kuhn (1962), though, rejected the idea of scientific progress towards some one final vision of the world. An increase in data collection and scientific knowledge has enabled the measurement of new societal areas or phenomenon, even if this new information has not necessary implied rapid changes in the relevant policy regimes, as best illustrated by the climate negotiations.

Politically, these observations will lead to a discussion about the remaining carbon budgets and the capping of energy consumption. Within the most influential of institutions, similarly as in the scientific discourse, different measures of progress seem to be layered on top of each other due to historical reasons. Previously, some statistics may have not been published due to lack of measurement technologies or awareness. In a sense regarding the debate over the measurement of (perceived) progress, it is mostly a historical and unfortunate coincidence that environment or climate dimensions have not previously been incorporated into high-level policy-making. However, as it stands, while the most influential of institutions from intergovernmental organisations to nation-states, and the people within them, have experienced the expansion of their knowledge basis about climate change, already causing changes in these policy actors; stagnancy and change resistance – these typical characteristics studied by the theories of 'new institutionalism' – seem to

be in friction with the capacity of these institutions to drive change. Actually, these international institutions and the example they set with their high consumption patterns are much at the heart of the dilemma of over-consumption.

From the sociological perspective, the evidence suggests that the emergence of national accounting created a powerful, but reductionist knowledge structure, nonetheless a captivating calculus of our daily life, as most of our daily interactions are manoeuvred through economic relations. What further legitimated this calculus (and legitimates it) was its alliance with the already legitimate and powerful state structure, in a Weberian sense. The examination of the mutually reinforcing relationship of statistics and politics (Erkkilä and Piironen 2009; Hauser 1973) has demonstrated, how political arithmetic became institutionalised and is now deeply embedded in our state structures (Hacking 1990; Foucault 1969, 1966); strengthening the relationship of the state and the economy, and the later calculations which became embedded to the welfare state, environmental and developmental policy.

For Latour (1987, 253), accountancy is a crucial and pervasive science of our societies. Porter (1992) considers quantification as a response to political problems, 'a part of the moral economy of science'. New challenges demand states as sovereign constructs built upon the (pre-)modernisation principles to adapt and meet demands of justice and find new operational criteria. Furthermore, the open data movement is only bound to drive the quantification of the society. While increased awareness may expand our bounded rationalities, Piironen and Erkkilä (2009, 126-127) fear that numerical objectifications of governance may also promote depoliticisation, and are critical towards standardised normative categories that would deny space for ethics and politics (Weber 1968; cited in Piironen and Erkkilä 2009, 127). Therefore, even if economisation (Çaliskan and Callon 2009) as such may not be a problem, but if ecological thresholds are subjected to value-laden economic quantification that triumphs other modes of reasoning, then there might lie a problem. And while it is seems recommendable that 'sustainable development' might be better attained with the support of strong institutions, it should be noted that technocratic thinking alone cannot solve the problems associated with consumption.

Too much trust in numbers may not only reveal, but also hide underlying political conflicts and mislead decision-makers into believing that complex and interrelated problems might be manageable thanks to the increased provision of information. While this study finds it essential to avoid a false framing of sustainable development in terms of relevant indicators, it has also been

important to deconstruct the techno-rationale of measurement as a management tool in order to assess the shortcomings of the approach. In the future, connectivity, openness of societies and increased access to scientific data may provide increased accountability and transparency, but also increasingly question the authority of scientific information. Even if the citizens together make the democratic constituency of a state, scientific information is not equally authoritative for all the different audiences. Therefore, this study suggests that an increased flow of information does not remove political conflicts or the need of deliberation of environmental, social, economic and cultural matters. Rather, they may be necessary before any changes in the international setting and global context are possible for solutions – that ultimately need to be political.

"Indicators are not an end in themselves. Their purpose is to alert the public and policymakers about the existence and cause of problems so that they might be solved."

(Cobb and Rixford 1998)

Annex I: Planetary boundaries

PLANETARY BOUNDARIES				
Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1–1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N_2 removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	Quantity of P flowing into the oceans (millions of tonnes per year)	11	8.5–9.5	~1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km^3 per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to cropland	15	11.7	Low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	To be determined		
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof	To be determined		

Boundaries for processes in red have been crossed. Data sources: ref. 10 and supplementary information

Source: Rockström et al. (2009). In 2009, Stockholm Resilience Centre convened 29 leading Earth-system scientists who as a result of their analysis proposed a set of nine critical Earth-system processes with 'tipping points' or gradients of increasing risk. At the time of the publication of their article, atmospheric aerosol loading and chemical pollution had not yet been quantified. Since 2009, these efforts have advanced. Raworth (2012a) adds that crossing the thresholds could impact first and hardest on people living in poverty whom depend directly on natural resources for their livelihoods and that these thresholds should not be interpreted as targets to allow governments to delay action before it is too late.

Annex II: Bellagio principles for sustainable development

In order to put sustainable development into practice, in 1996 a group of measurement researchers emerged with ten principles to assess progress towards sustainable development. The ten principles were reviewed in 2008. In order to highligh a few aspects, the original Bellagio principles included the likes of:

Principle 5: Practical focus
Assessment of progress toward sustainable development should be based on:

- an explicit set of categories or an organizing framework that links vision and goals to indicators and assessment criteria
- a limited number of key issues for analysis
- a limited number of indicators or indicator combinations to provide a clearer signal of progress
- standardizing measurement wherever possible to permit comparison
- comparing indicator values to targets, reference values, ranges, thresholds, or direction of trends, as appropriate

Principle 6: Openness
Assessment of progress toward sustainable development should:

- make the methods and data that are used accessible to all
- make explicit all judgments, assumptions, and uncertainties in data and interpretations

Principle 7: Effective communication
Assessment of progress toward sustainable development should:

- be designed to address the needs of the audience and set of users
- draw from indicators and other tools that are stimulating and serve to engage decision-makers
- aim, from the outset, for simplicity in structure and use of clear and plain language

Source: IISD (2013)

Annex III: Advantages and possible disadvantages of composite indices

Composite indices of sustainable development merge together economic, social and environmental dimensions into a one single score. This way they attempt to incorporate the three dimensions into one package.

Advantages	Possible disadvantages
• Can summarise complex, multi-dimensional realities and support decision-making • Easier to interpret than a battery of separate indicators • Can assess progress of countries over time • Reduce the visible size of a set of indicators without dropping the underlying information base • Make it possible to include more information within the existing size limit • Issues of country performance and progress at the center of the policy arena • Ease communication with general public (i.e. citizens, media, etc.) and promote accountability • Help to construct/underpin narratives for lay and literate audiences • Enable users to compare complex dimensions effectively	• Invites simplistic policy conclusions • Sends misleading policy messages, if either poorly constructed or misinterpreted • Possibility of misuse, such as support of a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles. • Selection of indicators and weights could be the subject of theoretical and political dispute • Disguises important failings in some dimensions and increases the difficulty of identify proper remedial action (in particular, if the construction process has not been transparent) • May lead to inappropriate policies, if those dimensions that are difficult to measure are ignored

Table 5: Pros and cons of composite indicators; adapted from OECD and EC-JRC (2008, 13-14)

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