



Towards an operational measurement of socio-ecological performance

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Socio-economic Sciences and Humanities Europe moving towards a new path of economic growth and social development - Collaborative project

Towards an operational measurement of socio-ecological performance

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Contribution to the Project

In this task we will critically review different approaches to measure well-being, particularly related to issues such as subjective well-being, capabilities approach, eco-system services and energy services. The focus of our appraisal is on their potential to derive indicators for use in macroeconomic modelling.

Keywords:

Academic research, Beyond GDP, Biophysical constraints, Ecological integrity, Economic growth path, Socio-ecological transition, Wealth, Wellbeing

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Abstract

Questioning GDP as dominant indicator for economic performance has become commonplace. For economists economic policy always aims for a broader array of goals (like income, employment, price stability, trade balance) alongside income, with income being the priority objective. The Stiglitz-Sen-Fitoussi Commission argued for extending and adapting key variables of macroeconomic analysis. International organisations such as the EC, OECD, Eurostat and UN have proposed extended arrays of macroeconomic indicators (see 'Beyond GDP', 'Compendium of wellbeing indicators', 'GDP and Beyond', 'Green Economy', 'Green Growth', 'Measuring Progress of Societies'). Despite these high profile efforts, few wellbeing and environmental variables are in use in macroeconomic models. The reasons for the low uptake of socio-ecological indicators in macroeconomic models range from path dependencies in modelling, technical limitations, indicator lists being long and unworkable, choices of indicators appearing ad hoc and poor data availability. In this paper we review key approaches and identify a limited list of candidate variables and – as much as possible – offer data sources.

1. Introduction

It has become commonplace to question the adequacy of current measures of economic performance. This search for new ground is augmented by a rising urgency to account for environmental change, social justice and inclusion. These challenges are important in themselves and they have an increasing impact on the wellbeing of citizens. A lively debate about competing concepts for measuring socio-ecological performance has unfolded in recent decades. What we measure affects what we do; and if our measurements are flawed, decisions may be distorted.

In this paper we hold the position that GDP as de facto sole indicator of macroeconomic success is misleading as a measure for the “greatest good for the greatest number”. Besides starting from production and consumption rather than wellbeing, it does not adequately account for environmental goods and services; when per capita figures are used, information about income distribution is lost and GDP being a flow variable is blind to levels in the capital stock¹.

The Europe 2020 Strategy explicitly acknowledges the need to focus on a broader array of indicators for measuring macroeconomic success². Europe 2020 is based on five EU headline targets which are currently measured by eight headline indicators. However, in Europe 2020 the focus remains on GDP growth. Instead we suggest a framework that emphasises the relevance of stocks (i.e. accounts for biophysical boundaries, social capital and justice) and aims to increase human wellbeing³. Safeguarding stocks contributes to human wellbeing, but wellbeing still needs to be accounted for separately.

The view that wellbeing needs to be better accounted for is entering the policy arena. “Measuring the nation's wellbeing as well as its wealth will make it easier for the Government to help British people attain the good life”, the British Prime Minister Cameron said in 2010.

For capturing impacts in the environment we need to account for an array of biophysical indicators in absolute terms and with reference to biophysical boundaries. Article 11 of the Treaty on the Functioning of the European Union states: “Environmental protection requirements must be integrated into the definition and implementation of the Union policies and activities, in particular with a view to promoting sustainable development” (EC 2008).

The UN Resolution 65/309 calls for a “more holistic approach to development” based on the notion of sustainable happiness and wellbeing; it invites countries to develop measures that capture provisions for the pursuit of happiness and wellbeing in public and development policies. Yet, policy makers and

¹ For a more comprehensive critique of GDP, see e.g. Slesnick, D. T. (1998). “Empirical Approaches to the Measurement of Welfare.” *Journal of Economic Literature* **36**: 2108-2165, Frey, B. S. and A. Stutzer (2002). “What can economists learn from happiness research?” *Journal of Economic Literature* **XL**(June 2002): 402-435, van den Bergh, J. C. J. M. (2009). “The GDP paradox.” *Journal of Economic Psychology* **30**(2): 117-135.

² Employment rate, gross domestic expenditure on R&D, greenhouse gas emissions, share of renewable energy in gross final energy consumption, primary energy consumption, early leavers from education and training, tertiary educational attainment, people at risk of poverty or social exclusion

³ Well-being tries to capture the true, complex, nature of human flourishing. It cannot be measured by use of one variable alone, such as happiness, life satisfaction or quality of life. Building blocks for a flourishing life include positive emotion, engagement, relationships, meaning and accomplishment.

macroeconomic advisors around the globe strive for higher economic growth. For the poor of the Global South and for people in the lowest income quintiles of OECD countries it is indeed essential to increase their incomes for improving wellbeing; but the evidence for the majority of people in OECD countries is mixed.

Besides the doubts about the desirability of GDP growth everywhere and all the time, doubts about the possibility to achieve GDP growth are growing. Increasingly we observe difficulties in achieving economic growth, especially in industrialised countries. Current forecasts range just above 1% (OECD 2013). Given that recent high growth periods have not contributed to resolving ongoing environmental crises and that income distribution has become more uneven, boosting per capita GDP is too narrow a focus. Stiglitz et al. (2009) suggest that median income should be used instead. International organisations such as the EU, OECD and UN have proposed extended arrays of macroeconomic indicators (see ‘GDP and beyond’ and ‘Compendium of wellbeing indicators’).

Due to the failure to realise absolute resource and energy decoupling, economic growth continues to cause increased resource use and emissions. We risk or are already trespassing significant biophysical planetary boundaries. The problems are well documented, the need for measuring the impacts is widely accepted, the literature on sustainability indicators is vast and statistics offices are reporting biophysical data in more details and ever more swiftly. Yet socio-ecological sustainability indicators are barely used in macroeconomic models. For supporting the socio-ecological transition better, the underlying models need to account for at least some key socio-ecological variables.

Despite high profile efforts of extending the measurement of economic performance, few wellbeing and ecological variables are in use in macroeconomic models. The reasons for the low uptake of an augmented range of socio-ecological indicators in macroeconomic models range from path dependencies in modeling, technical limitations, indicator lists being long and unworkable, the choice of indicators appearing ad hoc and poor data availability.

In our view, the literature on socio-ecological indicators lacks theoretical underpinnings. This is why we start by reviewing four approaches from sustainability science, ecological economics and new approaches of welfare economics, notably happiness economics, the capabilities approach, ecosystem services and energy services. These approaches have a promising conceptual base and have been used for empirical analyses. While drawing on a range of widely used approaches helps us to approach socio-ecological transitions in a more systematic way, we wish to emphasise that they rest on strong normative foundations, as does neoclassical economics. Drawing on these four approaches is an attempt to work constructively and systematically towards a better understanding of complex systems; there is no need to and we do not attempt to compare the four approaches.

In a second step we identify specific indicators that account for key aspects to adapt for socio-ecological transitions. We focus here on mobility, energy, food and housing as crucial societal domains with sustainability problems. On aggregate, these domains account for 70% to 80% of the life cycle environmental impacts of industrialized countries which provides a strong argument for policy intervention (see also UNEP 2010). In this paper we extend these areas of provision by “social inclusion” to highlight the need to better account for the social dimension of sustainability. Obviously

this list could be extended, but these areas cover the majority of energy and resource use. As much as possible we point to data sources and data itself.

2. Conceptual framework

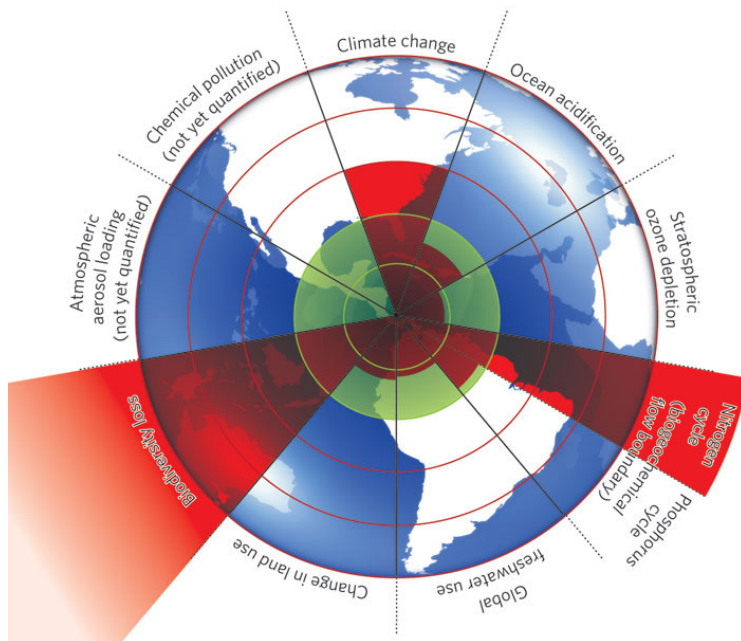
2.1 A safe and just space for humanity

Economic activity entails processes which interact with the biophysical sphere in various forms. Although Earth has undergone many periods of significant environmental change (see also Ponting 1991; Weisz, Fischer-Kowalski et al. 2001; Diamond 2005), the planet's environment has been unusually stable for the past 10,000 years. This period of stability — known to geologists as the Holocene (“the entire new”) — has seen human civilizations arise, develop and thrive.

Exploring the level of interference of humans with natural systems, Rockström et al. (2009) suggest that we may be close to leaving the safe operating space as measured by nine key earth system boundaries including the level of ocean acidification, rate of global freshwater use and chemical pollution. Three thresholds (greenhouse gas concentrations, rate of biodiversity loss, nitrogen removal from the atmosphere for human uses) may actually have been overstepped, which is shown in red in Figure 1.

Given the broad range and extent of direct and indirect interferences of human activity with the world ecosystems, Rockström et al. (2009) consequently underscore the proposal of Crutzen and Stoermer (2000) of relabeling our current geological age from Holocene to Anthropocene (“the human new”) (Kellie-Smith and Cox 2011; Steffen, Grinevald et al. 2011; Tickell 2011; Vidas 2011; Zalasiewicz, Williams et al. 2011).

Figure 1 **Earth system boundaries and human interference**



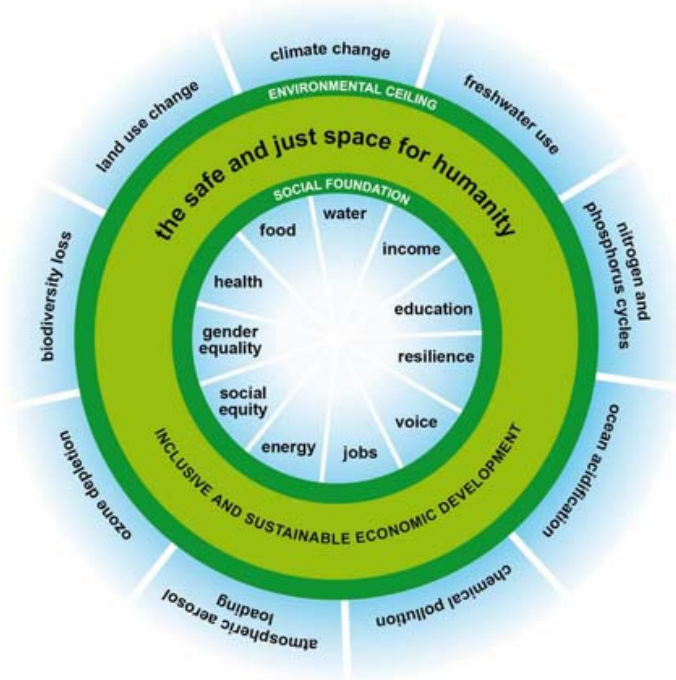
Source: (Rockström, Steffen et al. 2009)

Planetary boundaries propose the outer limits of pressure that humanity should place on critical Earth systems in order to protect human wellbeing. Empirical analyses on the Environmental Kuznets Curve hypothesis have illustrated that there is very mixed evidence on the relationship between economic growth and the various dimensions of environmental quality; certainly there is no systematic empirical support for the hypothesis (Stern, Common et al. 1996; Stagl 1999; Stern 2004). Hirsch (1976) had highlighted another development, namely the weakening link between economic growth and quality of life, access to education and social mobility. Raworth (2012) linked the environmental and social impacts directly. She suggests that similar to planetary boundaries beyond which lies environmental degradation that is dangerous for humanity, there are social boundaries below which lie resource deprivations that endanger human wellbeing.

Raworth (2012) represents social boundaries in poor countries by use of eleven indicators, highlights their illustrative nature and considers them in need of revision. In the absence of agreement about social boundaries Raworth derived them from the social issues that were raised as priorities in more than half of all government submissions to the UN's Rio+20 Conference on Sustainable Development in June 2012.

Combining the inner limits of social boundaries and the outer limits of planetary boundaries in this way creates a doughnut-shaped space, within which all of humanity can thrive by pursuing a range of possible pathways that could deliver inclusive and sustainable development (see Figure 2).

Figure 2 **Social and planetary boundaries: creating a safe and just space for humanity**

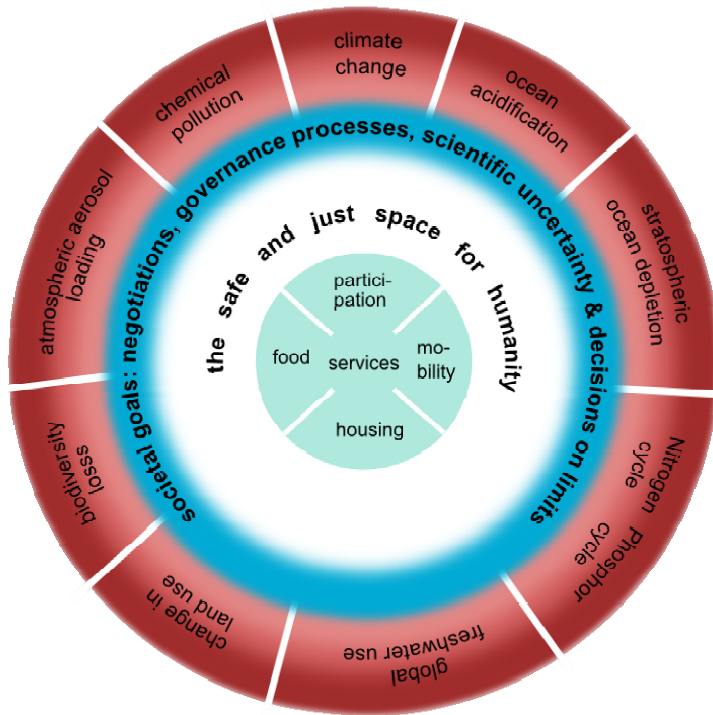


Source: (Raworth 2012)

This framework makes clear one of humanity's major challenges in the 21st century: to ensure that the use of Earth's resources fulfils the human needs of all – seven billion people, soon rising to nine billion – while simultaneously ensuring that the total pressure on Earth systems remains within planetary boundaries (Raworth 2012).

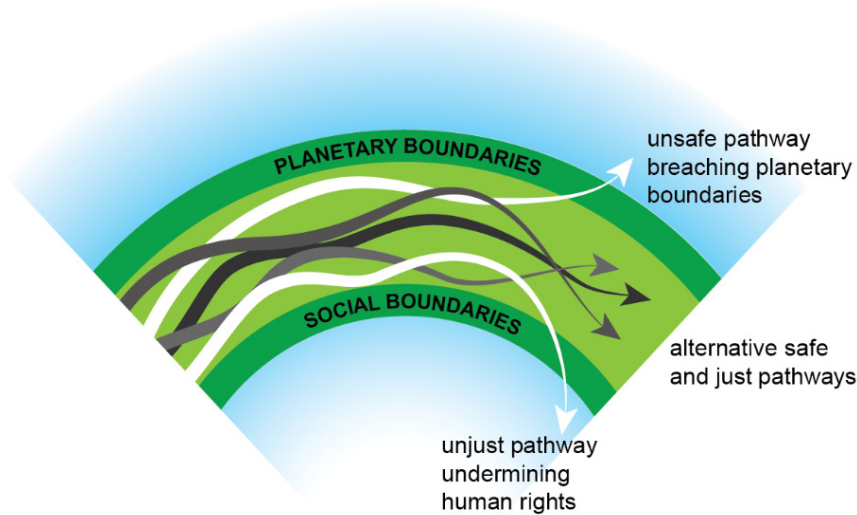
Building on these ideas of biophysical maxima and social minima we offer a systematisation of the social boundaries and an adaptation to the European context. As mentioned before, we focus on food, mobility, housing as they account for the vast majority of life cycle environmental impacts of industrialized countries. Together with social participation they cover key aspects contributing to human wellbeing. Figure 3 also illustrates the space of negotiations, governance processes and decisions on limits. Insights from natural sciences on planetary boundaries are important inputs on societal goals, but science cannot set the goals directly. Instead they are an important input in the governance process. Scientific studies are also subject to uncertainty, which can neither be ignored nor should it be used as an excuse for inaction (Funtowicz and Ravetz 1990). Instead governance processes need to embrace uncertainty by employing suitable decision support tools and participatory processes.

Figure 3 **Social and planetary boundaries – a European perspective**



This framework aims to specify the social and planetary boundaries between which humanity can thrive – but it does not suggest any specific pathways for getting into that safe and just space, or for thriving there. There are likely to be many possible pathways in that space, aligned with different cultures, visions and values, and with different distributions of costs, risks, power and benefits across social groups and generations, hence with diverse outcomes for social justice – and that makes the process of adjudicating between them a deeply political one (see Figure 4) (Leach, Raworth et al. 2013).

Figure 4 **Possibilities within the safe and just space: diverse pathways, alternative directions and varying distributional outcomes**

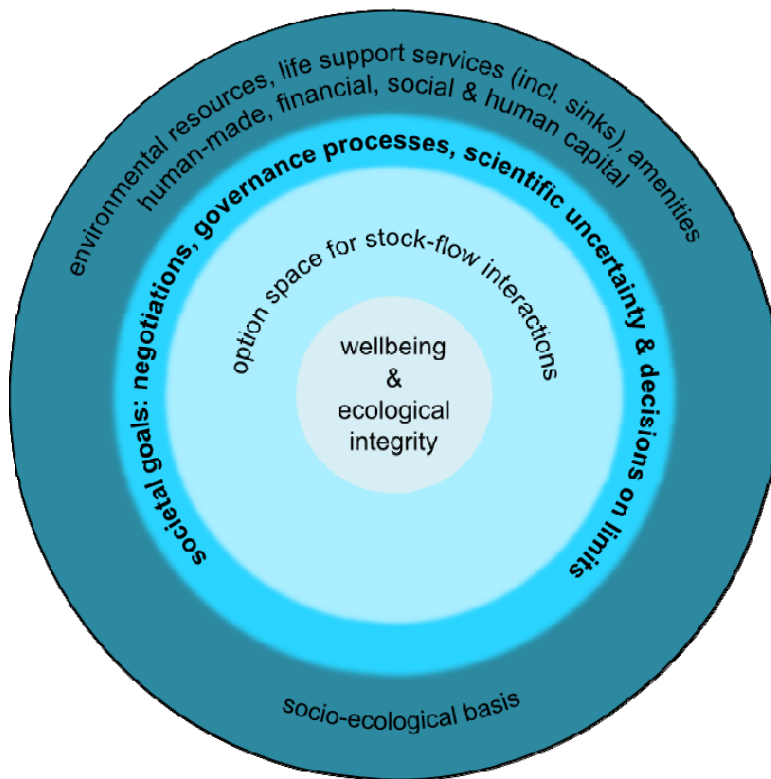


Source: (Leach, Raworth et al. 2013)

How can macroeconomic analysis account for these concerns? How can macroeconomic models adopt such a framing? Figure 3 illustrates a socio-ecological macroeconomic preanalytic vision from an output perspective and Figure 5 from an input perspective. Figure 4 illustrates the option space for a sustainable economy.

Safeguarding against an overuse of the biophysical sphere means that we need to account for an expanded input base, which includes environmental resources, life support services and amenities (Common and Stagl 2005). Additionally the stocks of machines, ideas and patents, financial structures, social relations and skills needs to be fully accounted for and included in models to ensure their overuse were detected. Together they form the socio-ecological basis of economic production. Their use is again mediated by negotiations, governance and decision processes. ‘Smart’ use of stocks and flows available in an economy generates wellbeing and ecological integrity.

Figure 5 **From the socio-ecological basis to wellbeing and ecological integrity**



In our view, wellbeing and ecological integrity are the ultimate goals, the focus of human activity. Wellbeing is often represented by material, social, cognitive and emotional dimensions. For a good life individuals need these dimensions to be reasonably well catered for. There are individually and culturally divergent levels of wellbeing minima that need to be achieved for well-functioning lives and communities. This framing also highlights that consumption of goods that yields no or minor additional wellbeing (overconsumption) is wasteful and counterproductive as it still depletes the socio-ecological basis. Similar to Leach's et al. (2013) diverse pathways, alternative directions and varying distributional outcomes, we move outwards to an option space for stock-flow interactions, which deliver services useful to humans and essential to ecosystems. The challenge for shaping these stock-flow interactions is to develop 'smart pathways of enough'.

2.2 Indicators for a safe and just space for humanity

Indicators help to account for different dimension of performance and allow policy makers to track progress – or the lack thereof. We should note here that indicator systems and accounting structures are not neutral. People often disagree not only on what to measure, but also on how to measure what they think is right to account for.

There are roughly three types of sustainability indicators: (1) Green GDP, (2) composite indicators and (3) systems of individual indicators. Efforts to identify a green GDP, i.e. a measure of production that accounts for negative externalities on the environment, date back to 1972 (Nordhaus 1972) and are in line with the ideas of green growth. (2) Composite indicators include a broader array of information than production into an index, which is quick to communicate and relatively easy to integrate in models. Indices require a weighting of the elements and opposing trends may disguise change. For example, OECD's Better-Life-Index, GPI, HDI. (3) Indicator systems of individual indicators are favoured by statistics agencies as they stay close to the collected data, avoid the problems of composite indicators, but are more difficult to communicate and to integrate into models. Last but not least some analysts argue that we should forego the use of GDP altogether as it is perceived as misleading and as standing in the way for the use of more pertinent indicators (van den Bergh 2009). In this paper we suggest using indicator systems for the reasons stated above and keep GDP as production measure and in order to facilitate communication with macroeconomic modelers.

Some of these sustainability indicators account for stocks and flows, but not systematically. Given that stocks for many resources are exhaustible, we consider it essential to account for the stocks as well as flows when aiming to support decision making for sustainability.

In 1981 James Tobin argued in his Nobel Lecture that models ought to track stocks. "Tracking of stocks. An essential part of the process is the dynamics of flows and stocks, investment and capital, saving and wealth, specific forms of saving and asset stocks. It is not generally defensible to ignore these relations on the excuse that the analysis refers to so short a time that stocks cannot change significantly." (Tobin 1981: 13; see also Tobin 1982)

Georgescu-Roegen differentiates further what is generally called stocks and flows. Georgescu-Roegen (1965; 1971) distinguishes between *stock* and *fund* and *flow* and *service*. Fund elements are those productive agents unchanged in the process⁴, that is, inputs that enter and exit in a form that is economically the same (e.g. labour). Flow elements are those inputs changed by fund agents into productive output, which is the focus of economic inquiry. The former represents the material base of the production process and the latter the transformation achieved with the services of this base. Although the distinctions can be sharply drawn, Georgescu-Roegen was quick to point out that the analytical boundaries could render a commodity a flow in one process and a fund in another.⁵

A stock is a type of productive input that may be used to generate flows at any given rate. For example, we may burn a ton of coal a day for 30 days, or we may burn the entire 30 tons in one day to produce the same total quantity of heat. A fund, on the other hand, may be used to generate services only at a limited rate. An individual labourer may dig one ditch a day for a month, but cannot dig 30 ditches in one day. The water filtering capacity of a wetland decreases if the amount of water flow exceeds some maximum rate. A stock is capable of producing a physical flow at any desired rate, but a fund is capable of producing a service only at a limited rate. It is limited by the time dimension as

⁴ Georgescu-Roegen's schematic illustration of funds is in our view somewhat exaggerated. It is obvious that labour changes in quality and quantity with workers learning, gaining experience, suffering burn-out and aging.

⁵ His example was clover seed, which is a fund in a process of producing clover seed but is a flow in a process of producing clover fodder.

well as by biophysical and institutional contexts. Funds are the "agents of production" that transform the flow of natural resources into a flow of economically valuable products (Daly 1995: 153; Gleria 1995). Funds must be maintained by the sustaining functions which support labour power, all capital, and Ricardian land. For example, a tired worker at the end of the working day must be refreshed by the sustaining functions of the household before she reenters the production process the next day (Gowdy and Mesner 1998).

This subtle, yet in our view important distinction raised by Georgescu-Roegen is almost never accounted for in macroeconomic modelling. The conceptual overlap and difference to important other approaches here, such as energy services sadly is beyond the scope of this paper.

Stocks are generally poorly represented in macroeconomic models. Stocks are harder to measure and while (resource) stocks are plentiful, there is reason to go through the trouble of accounting for them. Stock-flow-consistent models are an attempt to improve on this (Taylor 2004; Godley and Lavoie 2007). They model the economy based on a flow-of-funds-matrix. Each column shows a sector's balance sheet (for stocks) or sources and uses of funds (flows). Meanwhile, a row shows the stock or flow of an asset as it is distributed among the supplying and demanding sectors. This approach is now common in simulating models, but macro-econometric applications are scarce because of the consistency of the data mainly from balance sheet with those of the real economy (National Accounts).

Another modelling approach that accounts for stocks and flows systematically is 'dynamic systems models' (Ruth and Hannon 1997), which is used both by engineers, natural and social scientists alike. Forrester developed the approach which consists of feedback, accumulation of flows into stocks and time delays. System dynamics was also adopted when exploring for the Club of Rome the "predicament of mankind", that is, the global crisis that may appear sometime in the future, due to the demands being placed on the Earth's carrying capacity (its sources of renewable and nonrenewable resources and its sinks for the disposal of pollutants) by the world's exponentially growing population. The World3 model was built on the principles of dynamic systems modelling (Meadows, Meadows et al. 1972).

Next we review four approaches which capture key elements of this conceptual framework. There is no comprehensive approach yet, but borrowing from several approaches allows us to use different lenses and avenues to choosing suitable data.

3. Measuring socio-ecological performance – exploring different frameworks

3.1 Happiness economics

Research on life satisfaction or happiness has become a major branch in psychology, and is attracting huge interest among economists. Some economists now use satisfaction measures as proxies for the outcome which economic agents are assumed to maximize - namely, individual utility. Economists who, following the recent advice of the Commission on the Measurement of Economic Performance and Social Progress (Stiglitz, Sen et al. 2009), now intend to use direct satisfaction-based measures

of utility. The principal measure of wellbeing recommended by the Commission is self-reported feelings of satisfaction with life: All things considered, how satisfied are you with your life as a whole these days? Please use this card to help with your answer: 1 “dissatisfied” 2 3 4 5 6 7 8 9 10 “satisfied”.

The empirical evidence suggests that life goals, religion, and personal choices matter for happiness. Key choices relate to one’s partner, the trade off between work and leisure, social participation, and healthy lifestyle. Life goals and choices have as much or more impact on life satisfaction than variables routinely described as important in previous research, including extroversion and being married or partnered (Headey, Muffels et al. 2010)

For years the set-point theory was dominant; it said that long-term adult happiness is stable because it depends mainly on genetic factors, including personality traits molded and expressed early in life. It has been shown that major life events can temporarily change happiness levels, but that most people revert to their previous set-point within a year or two. The theory can be summarized by saying that, “We are all on a hedonic treadmill” (Headey, Muffel et al. 2010: 17922). The more recent literature has criticised set-point theory. Empirical studies indicate that long-term happiness can be substantially affected by individual choices, governmental and public policy decisions (Easterlin 2003; Headey, Muffels et al. 2010). In summary, life events in the non-pecuniary domain, such as marriage, divorce, and serious disability, have a lasting effect on happiness.

More critical to mainstream economics is that the assumption that “more is better” is problematic. Many economists still believe that wellbeing is increased by economic growth, and that the higher the growth rate, the greater the increase in wellbeing. An increase in income, and thus in the goods at one’s disposal, does not bring with it a lasting increase in happiness because of the negative effect on utility of hedonic adaptation and social comparison (Easterlin 2003).

Yet, individuals fail to anticipate the extent to which adaptation and social comparison undermine the benefits from income gains. Hence they allocate an excessive amount of time to pecuniary goals, and short-change non-pecuniary ends such as family life and health, reducing their happiness. There is need to devise policies that will yield better-informed individual preferences, and thereby increase individual and societal wellbeing (Easterlin 2003). Accounting for happiness in macroeconomic models can provide the systematic and empirically informed base for formulating such policies.

Recent critiques of the paradox, claiming the time series relationship between happiness and income is positive, is refuted by Easterlin (Easterlin, McVey et al. 2010).

Psychological wellbeing has been shown to forecast future physical health above and beyond its association with current physical health, and above and beyond its association with reduced levels of stress, depression, and other negative affective states (Fredrickson, Grewen et al. 2013).

Another relevant dimension studied in the happiness literature is the distribution of income and happiness. Similar to Transitions countries in Europe, Asian countries featuring high economic growth rates follow a U-shaped pattern which is apparently related to a pronounced rise in unemployment followed by a mild decline, and an accompanying dissolution of the social safety net along with growing income inequality. The burden of worsening life satisfaction in China has fallen chiefly on the

lowest socioeconomic groups. An initially highly egalitarian distribution of life satisfaction has been replaced by an increasingly unequal one, with decreasing life satisfaction in persons in the bottom third of the income distribution and increasing life satisfaction in those in the top third (Easterlin, Morgan et al. 2012). This illustrates the importance of income distribution for economic analysis leading to policy advice. As a minimum median income should be used in lieu of per capita income.

3.1.1 Terms and concepts

‘Subjective wellbeing’ is the general expression used to cover a range of individual self-reports of moods and life assessments (Helliwell, Layard et al. 2013). Subjective wellbeing (SWB) covers two aspects of persons’ experiences, happiness and life satisfaction. While often used interchangeably, the literature in psychology is clear: ‘happiness’ refers to emotional aspects (“How happy are you now?” or “How happy were you yesterday?”), while ‘life satisfaction’ refers to cognitive aspects (“How happy are you with your life as a whole these days?”).

Puzzles such as the following have drawn economists to empirical studies of SWB: (1) people systematically overestimate their satisfaction from future gains because they (nearly fully) adapt to them afterwards; (2) people compare themselves with their social peers to determine their relative standing (Frey and Stutzer 2002); if one’s income increases, so do others’ incomes, and so do social norms to increase consumption levels which leaves one in a similar relative state than before with similar SWB.

The ‘Leyden School’ of SWB developed a two- to three-layer satisfaction aggregation model in which they distinguish between different domain levels. Objective variables (like gender, age, and income) contribute to domain satisfaction levels (satisfaction with job, finances, housing, health, leisure, marriage, social life, environment, politics), which in turn contribute to general life satisfaction (Praag and Ferrer-i-Carbonell 2004).

The authors argue that these satisfaction domains are similarly structured, but represent different dimensions contributing to general life satisfaction. These domain levels can then be used like observed numerical variables in econometric one- and multiple-equation models.

Apart from the above example, most economists do not (yet) differentiate between different sub-dimensions of SWB because they aim to identify the determinants of overall life-satisfaction. Here, five sets of determinants are usefully distinguished (Frey and Stutzer 2002): Personality factors (e.g. self-esteem, personal control, optimism); socio-demographic factors (e.g. age, gender, marital status, education), micro- and macroeconomic factors (individual and aggregate income, unemployment, inflation); contextual and situational factors (employment and working conditions, work-related stress, interpersonal relations, living conditions, health); and finally institutional conditions and perceived governance structures (extent of political decentralization including direct political participation rights). Variables from all these areas have proven to contribute to general happiness, although personality factors are more often investigated by psychologists.

Arguing for including adaptation to income and other omitted variables, Di Tella and MacCulloch (2005) incorporate the following sets of variables into an ordered logit model: *Happiness = macro variables + micro variables + interaction terms + country dummies + year dummies + error term*

Table 1 **Determinants of happiness in 12 OECD nations 1975 – 1997**

<i>Basic dimensions</i>	<i>Variables</i>
<i>Aggregate level:</i>	
<i>Absolute income</i>	+ <i>GDP/capita; GDP growth</i>
<i>Government consumption</i>	+ <i>Final consumption expenditure as proportion of GDP</i>
<i>Generosity of the welfare state</i>	+ <i>Unemployment benefits (proportion)</i>
<i>Health</i>	+ <i>Life expectancy/years</i>
<i>Leisure (quantity)</i>	- <i>Average annual number of hours worked</i>
<i>Leisure (quality)</i>	- <i>Divorce rate</i>
<i>Environmental degradation / health</i>	- <i>SO_x emissions</i>
<i>Risk of crime</i>	- <i>Crime rate</i>
<i>Openness to trade</i>	- <i>(Imports + exports)/GDP</i>
<i>Inflation</i>	- <i>Inflation rate</i>
<i>Job security</i>	- <i>Unemployment rate</i>
<i>Individual level:</i>	
<i>Relative income</i>	+ <i>Personal income position relative to the country mean</i>
<i>Employment</i>	<i>Employment state</i>
<i>Individual characteristics</i>	<i>Male, age, education</i>
<i>Leisure (quality)</i>	<i>Marital status; - Size of community</i>

Note: Controlled for country and year dummies. See Di Tella and MacCulloch (2005) for methodology and variable descriptions. Signs show how variables enter the model. An inequality coefficient was insignificant because it is highly correlated with unemployment benefits.

In this study, GDP and extent of unemployment benefits are the largest positive contributors to happiness. The most detrimental contributions to happiness stem from the unemployment rate and the number of hours worked, but also the inflation rate is relevant. Apart from these aggregate variables, personal characteristics show less influence overall. The personal income position relative to the mean shows here the highest positive contribution, and being unemployed as well as being separated/divorced the largest negative. We note that social capital variables were only included via the marital status and the size of the community the person is living in.

The following is an application by Helliwell (2006), in which he proposes taking into account the institutional/political environment as well as social capital. Both of these dimensions had already been shown before to influence SWB.

Table 2 **Life satisfaction model by Helliwell (2006)**

<i>Basic dimensions</i>	<i>Variables</i>
<i>Social capital</i>	+ <i>Average memberships</i>
	+ <i>Social trust</i>
<i>Ethics</i>	+ <i>Belief in God</i>
<i>Intimate relationships</i>	- <i>Divorce rate</i>
<i>Employment status</i>	- <i>Unemployment rate</i>
<i>Health status</i>	+ <i>Self-reported health</i>
	+ <i>Total life expectancy</i>
<i>Institutional environment</i>	+ <i>Honesty and efficiency of government (effectiveness, regulatory efficiency, rule of law, lack of corruption)</i>
	+ <i>Operation of the democratic process (voice, accountability, political stability)</i>

Note: Signs show how variables enter the model.

The measurement of social capital variables is based on the insights of numerous studies that frequency and quality of contacts and its associated trust influence life satisfaction even more than financial income once a threshold to meet ones basic needs is surpassed. E.g. Helliwell and Putnam (2004) emphasize that social capital is strongly linked to subjective wellbeing in many ways whereby marriage, ties to friends, neighbours, and at the workplace are of capital importance and contribute to a climate of trust. They argue that all these variables, plus civic engagement, are independently and robustly related to life satisfaction, either directly or through their impact on health.

3.1.2 Stocks and Flows in happiness economics

In the SWB literature typically a subjective happiness or wellbeing variable is related to a set of explanatory variables:

$$\text{Subjective wellbeing} = h(w(y,z,t)) + e$$

where subjective wellbeing is typically measured via a survey question such as ‘taking all things together would you say you are *very happy*, *quite happy*, or *not very happy*,’ w is the ‘true’ wellbeing, $h(.)$ is a continuous non-differentiable function relating ‘actual’ to ‘reported’ (subjective) happiness, y is income, z is a set of demographic and personal characteristics, t is the time period, and e is an error-term.

Happiness, life satisfaction or satisfaction with domains (education or health systems, housing, transport infrastructure) are outcome variables; we call them ‘services’ as this is what users seek.

The SWB literature does not normally differentiate between stock and flow variables explaining outcome variables. However, as explained above, for our purposes this distinction is crucial. For example, ‘number of friends’ or ‘family situation’ are stock variables and ‘frequency and quality of social interaction’ a corresponding flow variable. Another example for a stock variable in ‘absence of unemployment’ and ‘job satisfaction’ being a corresponding flow variable. In the next section we illustrate possible stock and flow indicators as used in the literature in the four domains considered in this paper.

3.1.3 Happiness: Integration in indicator sets

SWB research tries to tackle some aspects of the complex concept of wellbeing. It is currently a lively area of conceptual modelling and empirical research. This makes it very attractive when searching for indicators of wellbeing suitable for inclusion in macroeconomic models.

Focussing on the domains mobility, housing, food and social participation and accounting for differences in stocks and flows we can identify a range of indicators.

On mobility a stock variable that has been found to relate to happiness is ‘availability of transport infrastructure’. Flow variables in this domain are ‘trip frequency in relation to going-out preference (like/dislike leaving the home)’, ‘changes in mobility experience over time’ and ‘effects (meaning) of driving reduction/cessation’.

Happiness is related to the ‘housing stock’ as well as the flow of ‘noise pollution in the home’.

On food a stock variable is ‘food in local shops and restaurants’ while ‘access to healthy meals’ and ‘eating in company’ are related flow variables.

The happiness literature has found that ‘social capital’ and ‘information channels’ are important stock variables, while ‘(interpersonal and institutional) trust’ and ‘frequency and quality of social interaction’ are related flow variables.

3.2 Capabilities approach

The second approach we are discussing in this working paper is the capabilities approach in which endowment and individual activity play a decisive role for wellbeing. In this context we stress the stock and flow perspective of capabilities, individual decisions and activities (e.g. the flow of years of school attendance accumulates to a stock of human capital). Stocks and flows depend on the one hand on individual factors but they are also embedded into the prevailing institutional framework, on the other.

The main protagonists of the capabilities approach are economist Amartya Sen who works on development, welfare and inequality issues and moral philosopher Martha Nussbaum. Both rely on a normative framework⁶ that is broadly accepted but leaves the question on how to reach such an accepted normative framework open.

3.2.1 Terms and concepts

The capability approach is a normative framework for the analysis and measurement of wellbeing, poverty and inequality (Robeyns 2005, 2006), pointing at the necessity to achieve societal consensus on relevant aspects. The approach was developed by Amartya Sen in the 1980s motivated by his critiques of traditional welfare economics and particularly its utilitarian basis (Clark 2005). In contrast to the traditional approach, Sen introduces a distinction between commodities, functionings/capabilities and utility. The capability approach views “living as a combination of various 'doings and beings', with quality of life to be assessed in terms of the capability to achieve valuable functionings” (Sen 1993). Functionings are the achievements of a person, i.e. her actual doings and beings, and can take both very elementary forms, such as being well-nourished or being healthy, and very complex forms, such as being socially integrated and being respected (Sen 1993). Functionings differ from the goods over which a person commands on the one hand and from the utility or happiness a person derives from a functioning on the other (e.g. Sen 1984). Which functionings a person can derive from a commodity, or – as Sen puts it – its characteristics respectively, depends on a wide range of conversion factors. Robeyns (2005) distinguishes three types of conversion factors: (1) personal conversion factors (e.g. metabolism, intelligence or physical condition), (2) social conversion factors (e.g. gender roles, public policies or social norms), and (3) environmental conversion factors (such as climate or geographical location). Sen (1984) therefore calls for a shift from “a focus on goods as such to what goods do to human beings”. According to Sen, an objective approach should be adopted to assess wellbeing and quality of life instead of using a subjective approach (see Muffles and Headey 2013): Disadvantaged people might e.g. report high levels of subjective wellbeing due to ignorance about the range of potential choices or as shown by happiness research people might adapt rather quickly to a new situation in their subjective assessment of quality of life.

The capabilities of a person denote the ‘alternative combinations of functionings’ she may achieve (Sen 1993). A person’s capability set hence describes the freedom to live the type of life she has

⁶ The capability approach as propagated by Sen relies on a rather open framework that emphasises the role of positive freedom for well-being in general while Nussbaum’s approach is more specific, i.e. defining a set of relevant capabilities.

reason to value. It is dependent on a wide range of (given) factors such as personal characteristics and the social or political environment (Sen 1993). The same functioning might be valued differently by different people.

According to Sen (1993), whether the focus should be on capabilities or functionings depends on the aspect of wellbeing to be measured or the development analysed⁷. For an assessment of a person's overall wellbeing, the focus should generally be on functionings (Sen 1993)⁸. For the analysis of poverty, Sen (1980) proposed the concept of 'basic capabilities' drawing on the concept of basic needs⁹. 'Basic capabilities' like the capabilities of being educated or well-nourished are defined as the "ability to satisfy certain crucially important functionings up to certain minimally adequate levels" (Sen 1993)¹⁰. The focus on basic capabilities, however defined, ensures that differences in the potentials to convert income into functionings are taken into account. Thus the capability approach provides an alternative conceptual framework for the analysis of poverty compared to income-based as applied e.g. in the EU.

Sen explicitly refrained from defining a list of key (basic) capabilities, but used particular selections in his empirical work (Robeyns 2005b, 2006; Alkire 2005). He argues that a selection of relevant capabilities would depend on personal value judgements (Clark 2005) and should hence rather be elaborated based on public reasoning. This reflects the challenge to define and to introduce a new normative setting versus a well established and accepted reference framework. Sen further argues that the relevant capabilities vary according to the scope of research, i.e. they would differ in an assessment of gender equality in Western countries and poverty in lower income countries (Sen 1993; Alkire 2005).

Sen has been criticised for not providing a list of capabilities. His critics include e.g. philosopher Martha Nussbaum who has pioneered the capability approach alongside Sen focusing on gender inequality. According to Nussbaum (2008), unequal (gender-specific) social and political circumstances, such as regimes that provide unequal access to education for males and females, result in unequal capabilities of women. Nussbaum emphasises that the analysis of wellbeing needs to focus on the individual level. An aggregation e.g. to family or regional level might conceal that women or other population groups are endowed with less opportunities than others. Nussbaum (2008) therefore stresses that the analysis of wellbeing shall follow "the principle of each person's capability, based on a principle of each person as end." However the individual capabilities are determined not only by individual factors but also by institutional and regulatory conditions.

⁷ Sen (1993) differentiates four evaluation purposes: (1) well-being achievement, (2) agency achievement, (3) well-being freedom, and (4) agency freedom.

⁸ For the assessment of a person's success in pursuing of all her aims, in contrast, the person's agency achievement would have to be assessed (Sen 1993).

⁹ The basic needs approach – put forward in the 1970s by the ILO World Employment Program – is one approach for measuring absolute poverty in developing countries. In the approach minimum resources necessary for physical well-being are defined, usually in terms of goods. The ILO report for the 1976 World Employment Conference defined basic needs in terms of food, clothing, housing, education, and public transportation (Emmerij 2010).

¹⁰ Sen has refrained from defining a specific list of crucially important capabilities and has neither provided guidelines for developing a list of basic capabilities (Ruggeri Laderchi et al. 2003). The same holds true for the definition (process) of threshold levels.

Like Sen, Nussbaum differentiates between functionings and capabilities. While Sen argues that the focus should be either on functionings or on capabilities depending on the purpose of the analysis, Nussbaum points out the importance of capabilities: “Where adult citizens are concerned, capability, not functioning, is the appropriate political goal.” (Nussbaum 2008), i.e. the freedom of the individual to live the life she wants is put in the centre.

Nussbaum defines a list of ten central human capabilities (e.g. Nussbaum 2008)¹¹: (1) life, (2) bodily health, (3) bodily integrity, (4) senses, imagination, and thought, (5) emotions, (6) practical reason, (7) affiliation, (8) other species, (9) play, and (10) control over one’s environment.

Nussbaum defines the ten capabilities broadly, so that people with different views can and will “interpret the moral core of the political conception to some extent differently”, but agree to it as a “type of overlapping consensus” (Nussbaum 2008). At first sight the list provides a clear normative notion of wellbeing or a good life. But at second glance it is a rather arbitrary selection and leaves any empirical indicator development nebulous. In the literature the presumption of universality has been frequently contested (e.g. Sen 2005; Robeyns 2005b; DeCesare 2011; Charusheela 2008; Jaggard 2006). Nussbaum herself admitted that the list was “humble”, “open-ended” and “open for discussion” (Nussbaum 2003).

According to Nussbaum, for each of the ten capabilities a threshold level should be defined by national governments (without specifying how national governments will agree on such thresholds). Nussbaum defines these thresholds as a minimum requirement for individual freedom of action “beneath which it is held that truly human functioning is not available for citizens” (Nussbaum 2008)¹². Policy should aim at guaranteeing that the threshold is reached for each and every person and each capability. Nussbaum recognizes two of them, practical reason and affiliation, of special importance, she stresses that the list might not be reduced to them and that trade-offs between different capabilities are not feasible.

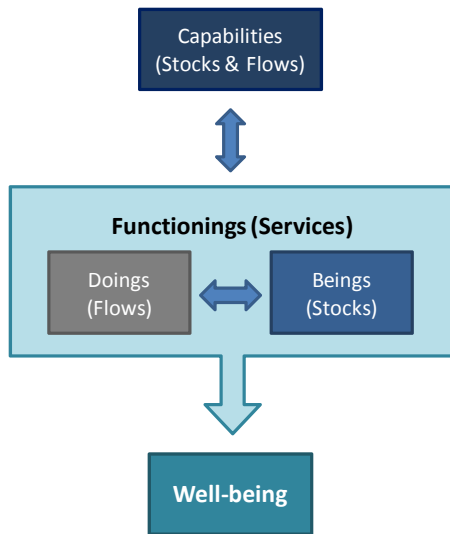
3.2.2 Stocks and Flows in the capability approach

Although not explicitly stated the interaction between stocks and flows is relevant for the capabilities approach. In some aspects this is straightforward; in others the relationship is more implicit. In Figure 6 we sketch the relevance of stocks and flows in the capabilities approach. The graph highlights on the one hand a dynamic aspect and on the other hand the interaction of stocks and flows on wellbeing. The dynamic aspect refers to a changing capabilities set that may result from individual choices. At a certain point in time the attained education level shapes the opportunities to participate in the labour market. Further education (doing) improves the education level (stock) and thus increases the opportunity set (capabilities). Stocks in the capability set are then all possibly attainable education levels. The flows refer to the necessary years of education that need to be invested to achieve a certain education level.

¹¹ A description of the capabilities is provided in the Appendix.

¹² Nussbaum (2007) suggests setting the individual threshold levels for individual capabilities “with an eye to the other capabilities”. The thresholds might differ between societies according different histories and circumstances and “should not be set in a utopian or unrealistic way” (Nussbaum 2007).

Figure 6 **Stock-flow-interactions in the capability approach**

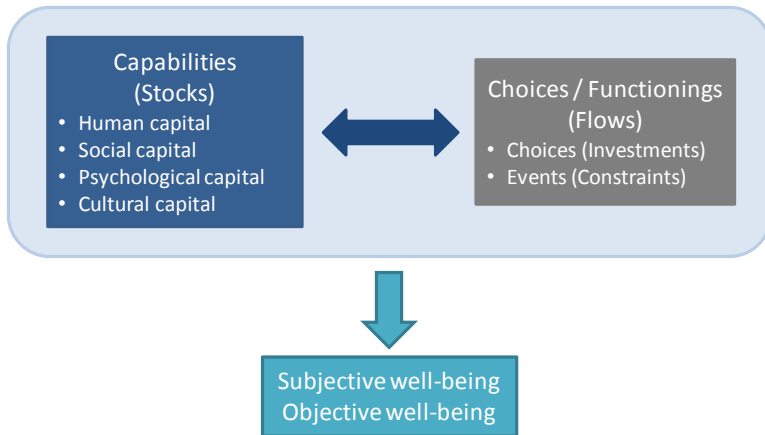


A similar mind set with respect to the relevance of stocks and flows is used by Muffles and Headey (2013). They apply the capability approach in a ‘capabilities-choices-events’ model. In contrast to our approach in which both capabilities and functionings can be either stocks or flows, they conceive capabilities and choices as stocks and flows respectively and apply this concept empirically for Germany and the UK.

In their paper, the analysed capabilities (stocks) are indicated by economic, social, cultural and psychological capital, as the different capital stocks determine people's opportunities¹³. Within their capability sets, people's efforts and choices (flows) determine their happiness and objective wellbeing, together with events, i.e. voluntary or involuntary choices such as marriage, divorce or the shut-down of a business that constrain future outcomes. According to Muffles and Headey (2013), wellbeing is then defined, as "the outcome of the interaction process between capabilities and choices" (see Figure 7).

¹³ The definition of capital stocks as capabilities is not straightforward, they could also be considered as conversion factors.

Figure 7 **Capabilities and functionings from a stock-flow perspective**



Source: Adapted from Muffles and Headey (2013).

Muffles and Heady (2013) empirically analyse the impact of capabilities and choices on wellbeing using data for Germany and the UK. In a panel econometric framework, they analyse the impact of the different stocks (capabilities indicators, e.g. education level, health status, job quality, social relationships) and flows (choices, e.g. training, healthy lifestyle, job search, social contacts) on subjective wellbeing (life satisfaction) and two indicators of objective wellbeing (relative income and employment security). From their empirical results the authors conclude that the capabilities framework provides evidence and has explanatory power for subjective and objective well being and what contributes to its changes over time. The authors point at the importance of capabilities, expressed in their modelling work as stocks, for income security and employment security.

3.2.3 Capability approach and wellbeing: Integration in indicator sets

In practice the capability approach takes many different forms¹⁴. This results partly from its wide scope and partly from its under-specification (Robeyns 2006). One aspect of under-specification refers to the use of functionings or capabilities for the analysis of wellbeing or poverty. Robeyns (2006) summarises arguments for both approaches. Those in favour of the use of capabilities imply that a focus on capabilities does not impose a particular notion of a good life and that individuals should have the same opportunities, but bear responsibility for their own choices. A focus on functionings, in contrast, is more appropriate when wellbeing is assessed. Furthermore, a focus on functionings might be owed to the fact that these are easier to measure.

There has been a lively debate whether and how the capability approach might be implemented in practice (see e.g. Alkire 2005, Jaggard 2006, Robeyns 2006). Up to now, however, the capability approach has been applied to the empirical assessment of a wide range of issues, including the general assessment of human development of countries (as in context of the human development report), the assessment of small-scale development projects, the assessment of poverty and wellbeing

¹⁴ Robeyns (2003) e.g. proposes the capability approach to study gender inequality in Western countries. Ruggeri Laderchi (1997) uses the capability approach for analysing poverty in Chile. Robeyns (2006) provides a comprehensive overview of further applications of the approach.

in developing and advanced economies and the deprivation of disabled people. Often these assessments draw on the list put forward by Martha Nussbaum (2008). While Sen explicitly argues for using capabilities and functionings as objective measures opposed to subjective assessments of wellbeing (see above), in practice the capability approach is often combined with subjective measures of life satisfaction, i.e. reported life satisfaction is regressed on certain capability indicators (e.g. Van Ootogem and Verholfstadt 2012, Anand et al. 2005, Anand et al. 2007, Anand and van Hees 2006, Muffles and Headey 2013).

The capability approach stresses the importance of the individual level, not least in order to be able to analyse inequalities e.g. between men and women. This advantage is diminished when data are condensed and aggregated for a composite index in order to increase communicability. An example for such a composite index based on Sen's work on the capabilities approach is the Human Development Index (HDI), that focuses on a cross-country comparison¹⁵. The HDI includes data on life expectancy, education and income. In other, general indicator frameworks (e.g. EU SDIs, UNISDs) only little information is provided, focussing on education, health and personal security.

The HDI has been criticised for the choice of indicators. This refers e.g. to the methodological background, i.e. the combination of stock and flow variables and input and output indicators, as well as to the selection of indicators for the three thematic areas (see e.g. Kovacevic 2010). Moreover, the selected indicators have not been considered adequate for a comparison of high-income countries - the HDI yields "very small differences among the top HDI countries, and thus the top of the HDI ranking often reflects only very small differences in these underlying indicators." (HDR 2006). Further criticism of the HDI applied to the correlation of indicators or the functional form of the HDI (see e.g. Kovacevic 2010). As an aggregate measure the HDI has especially been criticised for ignoring inequalities within countries (e.g. Hicks 1997; Grimm et al. 2010). As a result of this criticism inequality adjusted HDIs have been introduced. The Inequality-adjusted HDI takes differences in income into account and the Gender Inequality Index (see HDR 2010)¹⁶. Recently, it is being discussed to augment the HDI by environmental aspects. In addition to the currently used indicators, this 'sustainable' HDI should also include information on CO₂ emissions, water consumption, land / crop area, the ecological footprint, biodiversity and adjusted net savings.¹⁷

A strong focus on the relevance of distributional aspects for welfare and development is also given in the Stiglitz-Sen-Fitoussi Report (Stiglitz et al. 2009). Their criticism relates to the dominant role of aggregated information provided by National Accounts particularly GDP and GDP per capita.

The Stiglitz-Sen-Fitoussi Report covers a much broader array of topics, one of which is the relevance of environmental factors. This issue is dealt with in the next section on environmental services.

¹⁵ Since its first publication in 1990, the Human Development Report explicitly focuses on human capabilities. The 2011 Human Development Report defines human development as "the expansion of people's freedoms and capabilities to lead lives that they value and have reason to value." (HDR 2011).

¹⁶ Previously the Gender-related Development Index, the Gender Empowerment Measure, the Human Poverty Index have been used as inequality-adjusted measures in the Human Development Reports.

¹⁷ See http://www.wikiprogress.org/index.php/Towards_a_sustainable_Human_Development_Index_%28HDI%29.

3.3 Ecosystem services

Wellbeing features numerous different dimensions. Environmental aspects are one important determinant of people's quality of life (see e.g. Stiglitz et al. 2009). However this is still largely neglected in mainstream economics, National Accounts or other official databases. In order to measure the importance of ecosystem services statistical concepts in international organizations like the UN, OECD or EU have been developed. One milestone is the Handbook of National Accounting: Integrated Environment and Economic Accounting (SEEA; UNSD 1993) that aimed at augmenting standard National Accounts by satellite accounts capturing various environmental aspects. These statistical efforts mirror an increasing awareness of the importance of the environment for wellbeing and development. Along this work, in the recent past also a consultation draft on SEEA Experimental Ecosystem Accounting has been published which features a chapter on the 'accounting for ecosystem services in physical terms' (UNSD 2013).

3.3.1 Ecosystem services and wellbeing: Terms and concepts

Over the past years the concept of ecosystem services gained in importance in environmental and ecological economics, as ecological pressures and climate change became more evident. The 'modern' concept of ecosystem services can be traced back to the late 1970s where "the utilitarian framing of beneficial ecosystem functions as services in order to increase public interest in biodiversity conservation" (Gomez-Bagghetun et al. 2010) emerged. In the 1990s mainstreaming of ecosystem services, i.e. the broader diffusion of the concept, in research began with the seminal publications of Costanza and Daly (1992) and Daily (1997). In this process more attention was given to the monetary valuation of ecosystem services as by Costanza et al. (1997) (see Gomez-Bagghetun et al. 2010). The publication of the Millennium Ecosystem Assessment (MEA) in 2003 was a milestone in modern ecosystem service research and contributed to draw the attention of policy makers on the issue. Since then, the number of research papers on ecosystem services has grown exponentially (see Fisher et al. 2009).

Ecosystem services describe flows of materials, energy, and information from natural capital stocks¹⁸ that generate human wellbeing in combination with manufactured and human capital services (Costanza et al. 1997). Despite the growing body of literature, still no universally accepted definition of the concept of ecosystem services exists. On the general level, two strands of definitions can be distinguished (Nahlik et al. 2012): One equates ecosystem services directly with the benefits for human wellbeing (e.g. Costanza et al. 1997; MEA 2003)¹⁹; the other conceives ecosystem services as the consumption and use of ecosystem attributes (ecosystem attributes (i.e. biological, physical, or

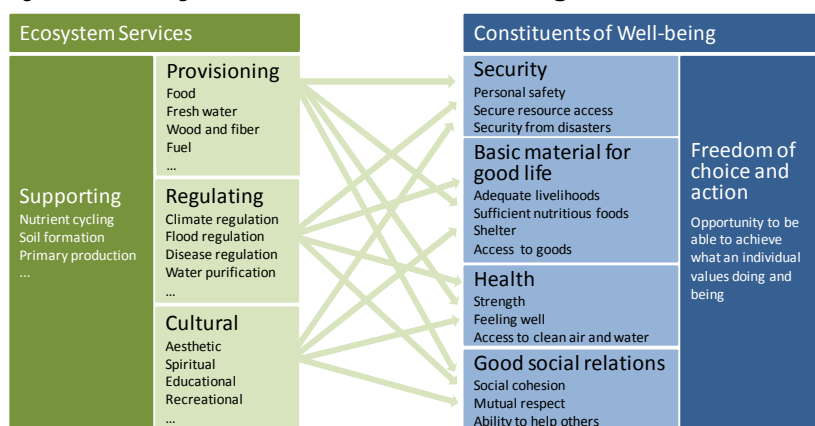
¹⁸ Natural capital stocks take different forms, most notably in physical forms (trees, minerals, ecosystems, the atmosphere, etc.). Furthermore, intangible capital stocks exist such as information stored in species and ecosystems (Costanza et al. 1997).

¹⁹ Costanza et al. (1997) define ecosystem services as "the benefits human population derive, directly or indirectly, from ecosystem functions". In the MEA (2003) ecosystem services are defined as "the benefits people obtain from ecosystems".

chemical characteristics of ecosystems) that give rise to wellbeing (e.g. Daily 1997; Boyd and Banzhaf 2007)²⁰.

A number of papers address the development of a categorisation of ecosystem services (e.g. Fisher et al. 2009; de Groot et al. 2002). Well accepted is the approach by the Millennium Ecosystem Assessment in which four broad categories of ecosystem services are distinguished (MEA 2003): provisioning services, regulating services, cultural services and supporting services (Figure 8). Provisioning services comprise all products from ecosystems that people receive such as food, materials and energy. Regulating ecosystem services refer to benefits from the regulation of environmental processes such as water purification or flood and erosion control. Cultural services comprise the intangible benefits humans receive from ecosystems related e.g. to recreational, inspirational and educational experiences (see Kandziora et al. 2013). Supporting services finally refer to those ecosystem services that are a precondition for the provision of other services (e.g. production of oxygen and soil formation).

Figure 8 **Ecosystem services and wellbeing**



Source: Adapted from MEA (2003).

From an accounting perspective, in the analysis of ecosystem services special emphasis has to be put on avoiding double-counting of services, i.e. intermediate and final goods need to be distinguished, as intermediate goods are also embodied in the value of final goods. This refers to ecosystem services both from different categories and from the same category. For example, pollination is a final regulating service on the one hand, but also an intermediate service for crop cultivation on the other. With respect to provisioning services, crop cultivation can be a final service or an input in stock-breeding. Boyd and Banzhaf (2007) therefore propose to distinguish between final and intermediate ecosystem services where “final ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human wellbeing.” The focus on final services entails that supporting services like soil formation – due to their intrinsic intermediate nature – are excluded. The same

²⁰ According to Daily (1997), ecosystem services are “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life”. Boyd and Banzhaf (2007) define ecosystem services as “components of nature, directly enjoyed, consumed, or used to yield human well-being”.

approach is followed in the SEEA Experimental Ecosystem Accounts (UNSD, 2013). Burkhard et al. (2012) propose to replace the concept of supporting ecosystem services by the concept of ecological integrity²¹ that is the “base for the supply of [final] regulating, provisioning and cultural ecosystem services”.

Ecosystem services are either valued in physical terms (e.g. tons of food) or in monetary terms (here, double-counting is of particular importance). The primary motivation for the valuation of ecosystem services is the analysis of policy options (with trade-offs between different services)²² and the integration of ecosystem services in accounting frameworks like the SEEA. Monetary valuation methods include, where feasible, valuation at market prices (with potential adjustments for labour and produced assets), replacement cost methods, the use of payments for ecosystem services and other valuation methods such as hedonic pricing, travel cost methods, willingness-to-pay methods and production function methods (see e.g. UNSD 2013; Edens and Hein 2013). Even though monetary valuation might enhance mainstreaming of the concept of ecosystem services in economics and policy-making, these approaches need to be used with caution as monetary valuation and potential aggregation are linked with the concept of weak sustainability (see e.g. Figge and Hahn 2004; Rennings and Wiggering 1997). Weak sustainability assumes that it is possible to substitute between the different capital forms and regards the maintenance of the total capital stock as sufficient condition for Sustainable Development. This view hence ignores that (some) natural goods and services cannot be replaced by manufactured goods and services.

3.3.2 Stocks and flows in ecosystem service research

Ecosystem services are generally thought of as flows being provided by natural capital stocks in combination with manufactured and human capital (e.g. Costanza et al. 1997). Following Georgescu-Roegen (1971), Farley and Costanza (2010), however, propose a differentiation between ecosystem goods as stock-flow resources and ecosystem services as fund-services. This distinction draws from the idea that the economy is connected with the ecosystem via flows in two distinct ways: First, via throughputs, i.e. physical flows of natural resources that are transformed into goods and finally disposed of to the ecosystem as waste. This type of resources can be deployed at any chosen rate and is used up in quantitative terms. Examples for stock-flow resources in this sense would be fossil fuels, minerals and renewable resources (see e.g. Farley and Daly 2011). Second, the economy is connected with nature via flows that have a service character. These fund-services are supplied by “a particular configuration of stock-flow resources” (Farley and Costanza 2010); the rate at which they can be used is given and they cannot be stockpiled. The provision of such services does not imply a physical transformation of resources, i.e. the resources are not used up. Examples for resources with a funds-service character would be solar energy or land area without taking into account quality (see e.g. Farley and Daly 2011). The broad definition of ecosystem services as followed above includes both types of flows.

²¹ Burkhard et al. (2012) define ecological integrity as “the preservation against nonspecific ecological risks that are general disturbances of the self-organizing capacity of ecological systems”.

²² E.g. whether natural landscapes should be converted into agricultural land.

3.3.3 Ecosystem services and wellbeing: Integration in indicator sets

For the development of general frameworks of ecosystem service indicators a driver-pressure-state-impact-response (DPSIR) approach has been recommended (Kandziora et al. 2013; Burkhard and Müller 2008): In this approach social, demographic, economic and life style developments form the starting point. The drivers generate pressures such as land use or emissions altering the state of an ecosystem. The changes in ecosystems in turn have impacts on the provision of ecosystem services as well as on the socio-economic system. Policy and society respond to these changes aiming at minimising negative impacts.

Ecosystem services are closely related to human wellbeing (Figure 8). They supply the basic material for a good life such as food, secure livelihoods and shelter, influence human health and social relations and affect security (including personal safety and secure access to resources). Moreover, ecosystem services influence freedom of choice and action and are a prerequisite for other constituents of wellbeing, including equity and fairness (MEA 2003).

In general indicator frameworks (e.g. EU SDIs, OECD BLIs) only provide little information on the state and development of ecosystems and ecosystem services. Most indicator sets include, however, information on drivers that determine changes in ecosystem services (e.g. changes in consumption, population etc.) and pressures exerted on the environment such as greenhouse gas emissions and waste generation.

The SEEA accounting framework, in contrast, pays particular attention to ecosystem services. Since the first handbook on environmental accounting was released in 2003, accounting for ecosystem services has been proposed as one possible extension to the core SEEA accounts (Edens and Hein 2013). As of spring 2013 a consultation draft on SEEA Experimental Ecosystem Accounting (UNSD 2013) and a proposal for a Common Classification of Ecosystem Services (CICES; see Haynes-Young and Potschin 2013) are available. Like in the SEEA core accounts, also for ecosystem services monetary and physical resource tables are proposed, differentiated i.a. according to the type of ecosystem and the type of service. To our best knowledge, ecosystem service accounts so far have, however, not been implemented.

With respect to data availability and quality, ecosystem services are poorly reflected. Nevertheless, as elaborated above, socio-economic development options are closely interlinked with them. This motivates to include the ecosystem service perspective in section 4.

3.4 Energy services

As a last approach, we address the concept of energy services as energy use is closely related to wellbeing and economic activity and the representation of energy use and supply in economic macro-modelling is comparably advanced. The relationship between stocks and flows is evident for the energy system, especially when concentrating on energy services²³ (e.g. mobility, room temperature) Energy flows are determined by the quality of the capital stock installed, e.g. heating energy demand

²³ That the analysis of energy systems should also focus on energy services was already proposed in the 1990s (e.g. Nakicenovic and Jefferson 1995; Nakicenovic et al. 1996).

depends on the thermal quality of the building shell. Energy services as a result from stocks and flows are ultimately relevant for wellbeing. Stock-flow-interactions for the provision of energy services are analysed in a number of research projects at WIFO (e.g. Kletzan et al. 2006; Köppl et al. 2011; Köppl et al. forthcoming; Kettner et al. 2012a; Kratena and Wüger 2010; Kratena et al. 2013) and are also reflected in a growing number of other research articles.

3.4.1 Energy services and wellbeing: Terms and concepts

Energy use and supply are closely interrelated with a wide range of environmental, social and economic aspects of wellbeing (e.g. Kettner et al. 2012a): First, energy is crucial for economic and social development. It provides basic energy services such as illumination, information or mobility and is a decisive input to all kinds of production processes and in service provision. Second, the use of energy entails major ecological impacts as e.g. a large part of anthropogenic greenhouse gas emissions (being a key driver for global warming and climate change) are related to fossil energy use²⁴. Third, current energy systems depend to a large extent on exhaustible fossil energy sources²⁵.

Energy services that can be defined as “the physical amenity provided by energy-using equipment” (Thomas et al. 2000) like cooking or illumination play a crucial role for the development of sustainable energy structures (see e.g. Köppl et al. 2011; Köppl et al. forthcoming; Kettner et al. 2012a,b; Haas et al. 2008; Ma et al. 2012; Gouveia et al. 2012; Cullen and Allwood 2010; Sovacool 2011a,b). It is not the quantity of energy used by households and companies that is relevant for wellbeing and development, but the amount and quality of the energy services consumed.

Energy services can be classified according to the following categories (Köppl et al. 2011): thermal services for heating of buildings and for production processes; mechanical services for mobility and stationary engines; and specific electric services for lighting, electronics and other appliances. Furthermore, direct and indirect energy services can be differentiated with the former including lighting, heating, cooking, cooling, washing and other activities involving the direct use of energy and the latter referring to energy embodied in goods and services such as clothing or buildings (Haas et al. 2008; Savacool 2011a).

As pointed out e.g. by Köppl et al. (2011) and Ma et al. (2012), data on energy services is not readily available. Therefore, the analysis of energy systems focuses generally on energy flows instead of energy services. Such a perspective and a strong focus on energy supply suggest that “fuels and technologies are the only important elements of energy systems”, a narrow perspective which might foster lock-ins in inefficient structures (Gouveia et al. 2012). The concept of energy services recently

²⁴ Also, the emissions of other air pollutants are closely related to fossil energy use. From the social perspective energy is of relevance as it is not only required for the satisfaction of basic needs but also represents a significant share in household expenditures, especially in lower income percentiles.

²⁵ Manifold interrelations between the social, environmental and economic aspects associated with energy use and supply can be observed (e.g. Kettner et al. 2012a; IEA/IAEA 2001). Driving forces from the economic sphere such as income disparities can translate into unequal access to energy and thus affect the social dimension: Lower income, on the one hand, may constrain investment opportunities for increasing energy efficiency of buildings or heating systems with negative impacts on the environmental dimension. On the other hand, lower income may be associated with lower demand for motorised individual transport entailing lower detrimental environmental effects than mobility patterns of high-income households. Economic activity is one driving force of energy demand with a corresponding impact on the environment.

gained in importance in studies of (sustainable) energy development both in less developed countries (including gender disparities) or in Western urban areas (Oparaocha and Dutta 2011; Ma et al. 2012; Gouveia et al. 2012; Chaturvedi et al. forthcoming; Sovacool 2011a,b).

3.4.2 Stocks and flows in the energy service approach

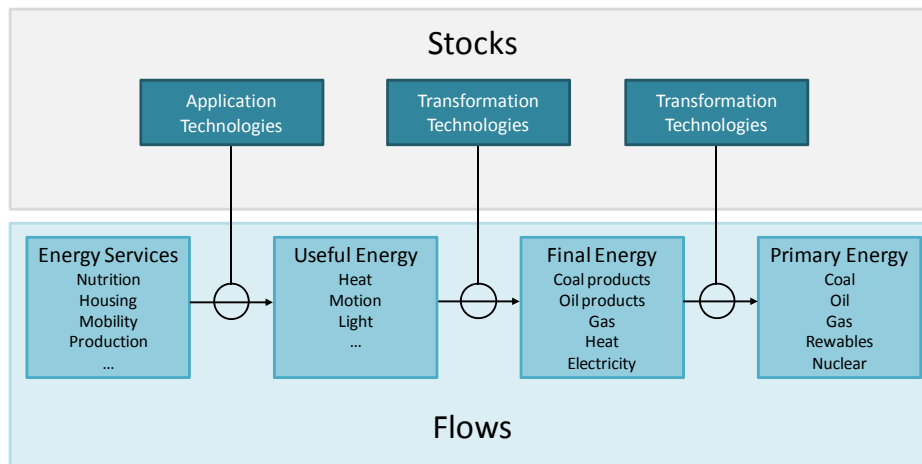
A given level of energy services can be provided by different combinations of technologies and energy flows. The range of available technologies and energy carriers thus opens up a spectrum of options, entailing different environmental impacts for any given energy service level. From a sustainability point of view, energy services should hence be provided with the lowest possible environmental impact, e.g. with low input of (fossil) fuels and minimal greenhouse gas emissions.

The energy efficiency of the capital stock and the corresponding greenhouse gas emissions associated with a certain level of energy services are key determinants of energy flows. A similar perspective as in Köppl et al. (2011) and Kettner et al. (2012a) is given in Cullen and Allwood (2012) who distinguish between the efficiency of conversion technologies and the efficiency of technologies generating the energy services demanded, the 'passive system'. Passive systems denote systems "to which useful energy [...] is delivered" (Cullen and Allwood 2012); they are not part of the conversion process, but instead, in passive systems useful energy is emitted as low-grade heat in exchange for energy service provision. The energy service 'comfortable room temperature' is e.g. provided by a conversion device, the heating system, and a passive system, the building. The distinction between passive system and conversion device reflects the different underlying technological processes (Ma et al. 2012). It furthermore allows differentiating between energy efficiency at different stages of the energy chain, i.e. at fuel transformation and at end-use conversion (Cullen and Allwood 2012).

This relationship between energy services, energy flows, technologies, driving forces of energy consumption and supply and related greenhouse gas emissions is depicted in Figure 9²⁶. The efficiency of the application technologies, or passive systems, determines the amount of useful energy required to deliver energy services, e.g. the thermal quality of the building shell determines the amount of heat needed to deliver a comfortable room temperature. How much final and respectively primary energy is needed to supply the useful energy required depends on the efficiency of the conversion or transformation technologies at the end user (e.g. efficiency of the heating system) or of the energy supplying companies (e.g. efficiency of electric power plants).

²⁶ The energy service approach as discussed here concentrates on human made capital as stocks. Nevertheless, physical energy stocks play a key role in the provision of energy services.

Figure 9 **Stocks and flows in the energy service approach**



Source: Own illustration based on Köppl et al. (2011).

3.4.3 Energy services and wellbeing: Integration in indicator sets

The central role of energy for wellbeing and sustainability is widely recognised in different indicator sets (e.g. EU 2005a,b; UNCSO 2001). Some indicator sets such as the IEA/IAEA Sustainable Energy Development (SED) Indicators or the IAEA Energy Indicators for Sustainable Development focus on energy as a key element for sustainability and wellbeing. Although energy is not an end in itself, as an input in the provision of energy services it is central to improved social and economic wellbeing (IAEA et al. 2005). The SED indicators measure the development towards “the provision of adequate energy services at affordable cost in a secure and environmentally benign manner, in conformity with social and economic development needs” (IEA and IAEA 2001). IEA and IAEA proposed 41 indicators for sustainable energy development covering the whole energy system and major driving forces such as economic and social development. This means the indicators cover primary energy supply, transformation technologies and final energy demand as well as energy intensities, fuel mix and demand for energy services. Economic factors (e.g. GDP, prices) and social factors (e.g. population growth) influence the energy system and emissions resulting from energy consumption and energy supply. By now, the IEA SED indicators have been applied to a number of countries (e.g. Lithuania (Streimikiene 2005), Cuba (Pérez et al. 2005), and Mexico (Medina-Ross et al. 2005)). Kettner et al. (2012a,b) refined the framework proposed by IEA and IAEA and developed a set of energy indicators focusing on energy services. This indicator set covers all levels of the energy chain and was composed for the EU 27 countries.

For the energy service approach the relevance of stock-flow interactions is evident. The manifold combinations of behaviour, technology and energy flows establish an ample option space for supplying wellbeing relevant energy services in a more or less sustainable way. Examples of stock and flow indicators from an energy service perspective are illustrated in the selection of indicators in the next section along indicators that are considered relevant in happiness, capabilities and ecosystem research.

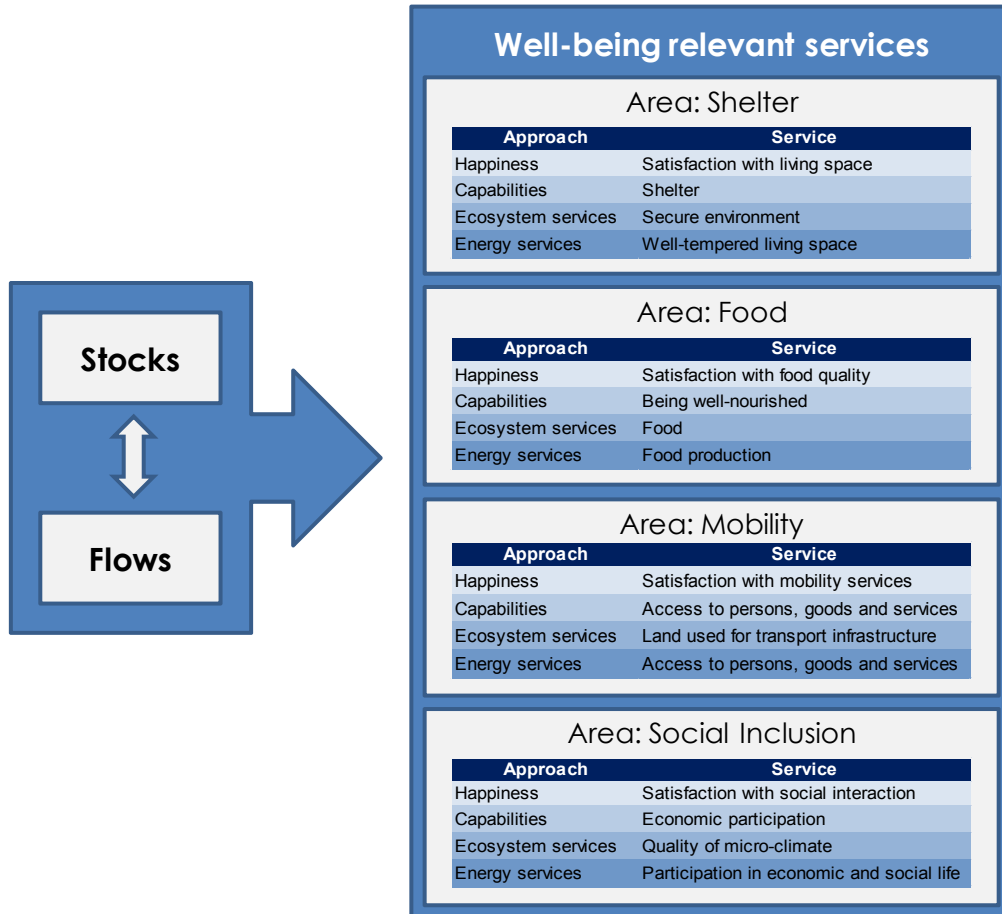
4. Candidate variables for capturing socio-ecological performance

The National Accounts are the well established basis for economic modelling. Although a growing attention for other aspects of economic and societal development can be observed, the dominance of GDP is still prevailing in economic debate. Whether wellbeing in a broader sense, i.e. subsuming environmental, social and economic aspects, compared to monetary welfare will gain in importance in the political discussion and in economic modelling depends on societal consensus on what is important for development and wellbeing on the one hand and on the availability of adequate measures on the other.

Following the discussion of our conceptual framework and four relevant concepts from the literature we suggest a list of possible indicators for four exemplary areas of wellbeing: shelter, food, mobility and social participation. The selection of these areas follows from their relevance to the four conceptual approaches of wellbeing discussed above. Besides that they are also reflected in a number of ad-hoc indicator frameworks on wellbeing and sustainable development (e.g. OECD How's life indicators, EU Sustainable Development Indicators). The indicators compiled in Table 3 are far from being exhaustive but can be regarded as an appetizer that illustrates how a stock-flow-service perspective for relevant areas could be operationalised in an indicator system.

The guiding principle for the selection of indicators is to first identify wellbeing-relevant services for each of the discussed approaches (happiness, capabilities, ecosystem services, energy services). These wellbeing-relevant services are presented in Figure 10. The figure also encompasses our line of argumentation, namely that services are the result of stock flow interactions.

Figure 10 **Exemplary wellbeing relevant services provided by stocks and flows reflecting diverse approaches**




Data on services as specified in Figure 10 are usually not collected and cannot be derived from official databases. In our line of argumentation services are the result of stock-flow interactions. We therefore propose indicators for relevant stocks and flows and for which data are available. We aimed at picking indicators that are available for as many EU Member States as possible and that are continuously updated and hence cover more than a single year. Therefore most of the proposed measures have been derived from Eurostat, the Odyssee database and the UNFCCC greenhouse gas inventories.

The database is organised as follows: For each area (shelter, food, mobility and social inclusion) and each approach, exemplary stock measures and the corresponding flow indicators are compiled. Table 3 summarises the content of the database in the supplementary material to this working paper. The colours in the columns "coverage" and "years" indicate the quality of the data with respect to regional availability and time coverage. Green represents broad coverage, yellow points at data gaps, red implicates low data quality and grey signifies areas where data are missing.

The table illustrates that data availability differs significantly between the four areas and approaches. In addition statistical representation of stock data tends to be poorer than for flow data. This corresponds to the underrepresentation of stock flow interactions in economic modelling.

Table 3 **Exemplary stock and flow indicators reflecting diverse approaches**



Stocks				Flows					
		Coverage	Years	Source		Coverage	Years	Source	
Shelter									
Happiness	Proportion of population living in households considering that they suffer from noise	EU27	2005-2001	Eurostat	Share of disposable income used for housing	EU27	2005-2011	Eurostat	
	Share of populations that is satisfied with housing	EU27	2007	Gallup World Poll					
	Share of population living in poverty	EU27	2000-2011	Eurostat					
Capabilities	Dwellings	EU27	1990-2009	Odyssee	Household investment dwellings	EU27	1990-2012	Eurostat	
	Floor Area	EU27	1990-2009	Odyssee		Maintenance costs dwellings	EU27	1990-2011	Eurostat
Ecosystem services	Vulnerability Index				Expenditures for food protection				
					CO2-emissions households	EU27	1990-2010	IEA	
Energy services	Buildings by construction period				Final energy consumption for space heating	EU27	1990-2009	Odyssee	
	Efficiency of buildings by building type				Share of fossil fuels for space heating	EU27	1990-2009	Odyssee	
Food									
Happiness	Perceived health status	OECD	1990-2011	OECD	Share of household expenditures used for food (first quintile)	EU27	1994-2005	Eurostat	
	Share of people satisfied with food								
	Share of population living in poverty	EU27	2000-2011	Eurostat					
Capabilities	Overweight and obesity	OECD	1990-2011	OECD	Total calories intake	OECD	1990-2009	OECD	
Ecosystem services	Organic farmland	EU27	2000-2011	Eurostat	Share of organic food sales	EU27	2009-2010	FIBL	
					GHG emissions agriculture	EU27	1990-2010	UNFCCC	
Energy services	Capital stock food industry				GHG emissions food industry	EU27	1990-2010	UNFCCC	
		EU27	1990-2007	FAO	Final energy consumption food industry	EU27	1990-2009	Odyssee	
					Final energy consumption agriculture	EU27	1990-2009	Odyssee	
Mobility									
Happiness	Share of commuters	EU27	1999-2012	Eurostat	Commuting time	EU27	2000	How's life	
Capabilities	Car stock	EU27	1990-2009	Odyssee	Passenger km travelled by cars				
	Bus stock	EU27	1990-2009	Odyssee					
	Motorcycle stock	EU27	1990-2009	Odyssee					
Ecosystem services	Truck and light vehicles stock	EU27	1990-2009	Odyssee	Road freight transport in tonne km	EU27	1990-2009	Odyssee	
	Length of motorways	EU27	1990-2011	Eurostat	Transport gross investment spendings	EU27	1995-2011	OECD	
	Length of other roads	EU27	1990-2011	Eurostat	CO2-Emissions transport	EU27	1990-2010	UNFCCC	
Energy services	Car stock	EU27	1990-2009	Odyssee	Final energy consumption cars	EU27	1990-2009	Odyssee	
	Bus stock	EU27	1990-2009	Odyssee	Final energy consumption bus	EU27	1990-2009	Odyssee	
	Motorcycle stock	EU27	1990-2009	Odyssee	Final energy consumption motorcycle	EU27	1990-2009	Odyssee	
	Truck and light vehicles stock	EU27	1990-2009	Odyssee	Final energy consumption trucks and light vehicles	EU27	1990-2009	Odyssee	
					Share of expenditures for transport services	EU27	1995	Eurostat	
Social Inclusion									
Happiness	Share of population with reliable helpers	EU27	2010	How's life	Weekly interactions with friends or family	EU27	2006	Eurostat	
	Number of friends								
Capabilities	Share of population volunteering	EU27	2008		Time spent for volunteering (forthcoming)	EU27	2012	ESS	
	Unemployment rate	EU27	2000-2012	Eurostat	Disposable household income	EU27	2000-2011	Eurostat	
Ecosystem services	Job quality				Years of education	EU27	2000-2011	Eurostat	
	Share of population without access to public green space	EU27	2000	Eurostat	Surface sealing	Austria	2008-2011	UBA	
Energy services	Share of population with access to good public transport				Share of expenditures for public transport services	EU27	19990-2011	Eurostat	

5. Conclusions

Despite high profile efforts of extending the measurement of economic performance progress to include wellbeing and ecological variables in macroeconomic analysis and economic policies is limited.

We conclude that it is necessary to (1) widening the lens in macroeconomic modeling, (2) a better conceptual base which we search for in this paper by reviewing four approaches; and (3) conceptually accounting for and measuring stocks and flows (and possibly funds and services as well).

This still leaves out the important question of justice (measured here crudely with income distribution). It is key to account for socio-ecological change as this opens up novel possibilities for economic policies leading to higher sustainability.

In this paper we developed a short list of stock-flow indicators suitable for inclusion in macroeconomic models. Our approach tries to overcome two key shortcomings of the literature: lack of theoretical underpinning and lack of operationality / proximity to data.

In reviewing four approaches from sustainability science, happiness research and ecological economics, we found that they have different starting points and foci, but can be useful in identifying key indicators of wellbeing and sustainability. Following the different approaches leads sometimes to similar indicators or even the same indicators. We see these as indicators with multiple justifications pointing in the same direction. While we tried to identify data sources relating to the variables and indicators chosen, for some data are not available (yet); we see this more as a future task for statistics offices than a weakness of the indicator list.

We illustrated how this extended basis of socio-ecological indicators can be offered in such a way that it is conducive to integration in macroeconomic models. Point to some attempts by macroeconomists, but argue that it is still a long way to go and name to key areas that need to be dealt with.

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Appendix

1. Life. Being able to live to the end of a human life of normal length; not dying prematurely, or before one's life is so reduced as to be not worth living.
2. Bodily Health. Being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter.
3. Bodily Integrity. Being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction.
4. Senses, Imagination, and Thought. Being able to use the senses, to imagine, think, and to reason—and to do these things in a “truly human” way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth. Being able to use one's mind in ways protected by guarantees of freedom of expression with respect to both political and artistic speech, and freedom of religious exercise. Being able to have pleasurable experiences and to avoid non-beneficial pain.
5. Emotions. Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude, and justified anger. Not having one's emotional development blighted by fear and anxiety. (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development.)
6. Practical Reason. Being able to form a conception of the good and to engage in critical reflection about the planning of one's life. (This entails protection for the liberty of conscience and religious observance.)
7. Affiliation.
 - a. Being able to live with and toward others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another. (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedom of assembly and political speech.)
 - b. Having the social bases of self-respect and non-humiliation; being able to be treated as a dignified being whose worth is equal to that of others. This entails provisions of non-discrimination on the basis of race, sex, sexual orientation, ethnicity, caste, religion, national origin.
8. Other Species. Being able to live with concern for and in relation to animals, plants, and the world of nature.
9. Play. Being able to laugh, to play, to enjoy recreational activities.
10. Control over One's Environment.

- a. Political. Being able to participate effectively in political choices that govern one's life; having the right of political participation and protections of free speech and association.
- b. Material. Being able to hold property (both land and movable goods), and having property rights on an equal basis with others; having the right to seek employment on an equal basis with others; having the freedom from unwarranted search and seizure.



Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs change. The financial crisis has exposed long-neglected deficiencies in the present growth path, most visibly in the areas of unemployment and public debt. At the same time, Europe has to cope with new challenges, ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundation for a new development strategy that will enable a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four-year research project within the 7th Framework Programme funded by the European Commission was launched in April 2012. The consortium brings together researchers from 33 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). The project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

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